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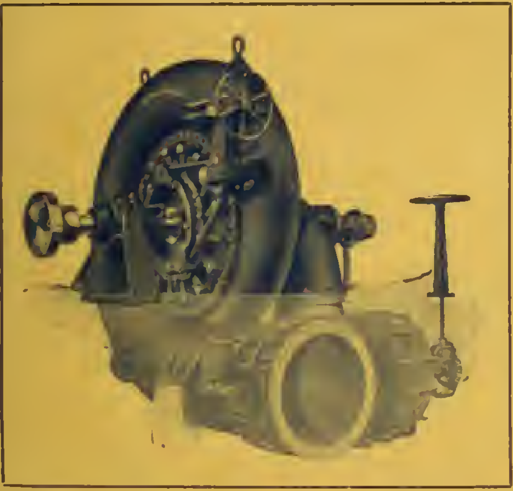
Vol. XXIII – No. 1

Toronto, January 1, 1914

Electrical News

Generation, Transmission and Application of Electricity



90% EFFICIENCY

From SMITH HYDRAULIC TURBINES

Recent tests at Holyoke, Mass. on Standard Smith Turbines have again proven their superiority over any turbine now manufactured.

These tests showing efficiencies from **89% to over 90%.**

We design and build turbines for heads from 5 feet to 650 feet. Engraving represents a turbine of 900 H.P., 250 R.P.M., 110 feet head.

Send for Bulletin N

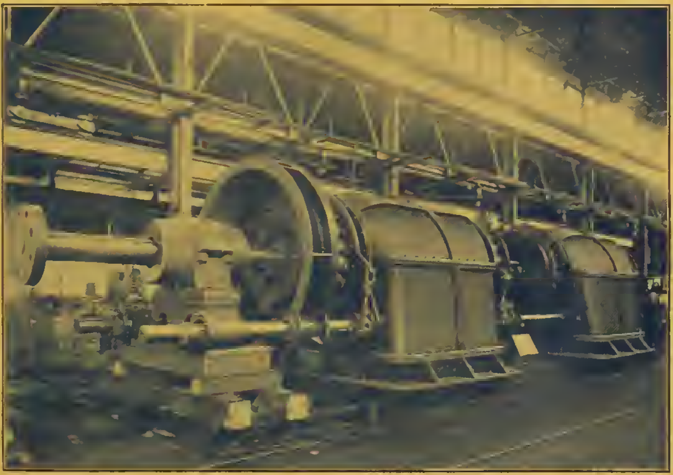
S. Morgan Smith Co., York, Pa.

Branch Offices: 176 Federal St., BOSTON, MASS.
614 American Trust Bldg., CHICAGO

HYDRAULIC TURBINES

Specially designed for Electrical Work

Note the strong regulating shaft and the heavy substantial construction of this unit.



Turbines,
Governors,
Penstocks,
Butterfly Valves,
and all
auxiliary
apparatus.

Quadruplex Turbine to be set in Open Flume.

5,350 H.P. 237 R.P.M. 50 ft. Head

CANADIAN ALLIS-CHALMERS,
LIMITED

Head Office: TORONTO. District Sales Offices: Montreal, Halifax, Ottawa, Cobalt, Porcupine, Fort William, Winnipeg, Regina, Saskatoon, Calgary, Edmonton, Nelson, Vancouver, Victoria, Prince Rupert.

PHILLIPS

Bare and Insulated Copper

WIRES AND CABLES

For Telephone, Telegraph, Lighting,
Power and Street Railway Equipment

Bare and Insulated Electric Wire and
Cables for Aerial and Underground use

Railway, Feeder and Trolley Wire

Weatherproof Magnet
and Rubber Covered
Wires and Cables

Incandescent and Flexible Cords

Eugene F. Phillips Electrical Works, Limited

MONTREAL - - CANADA

Branches: Halifax, Toronto, Winnipeg, Vancouver

MAKE YOUR FIRST RESOLUTION
OF THE
NEW YEAR

"BUY BENJAMIN"

- Sockets
- Receptacles
- Fittings
- Fixtures
- Reflectors
- C-H Specialties
- Insulating Joints
- Canopy Insulators
- Knife Switches
- Wiring Devices

Write for catalog C-21

"BUY BENJAMIN"
Made in Canada
FROM YOUR JOBBER

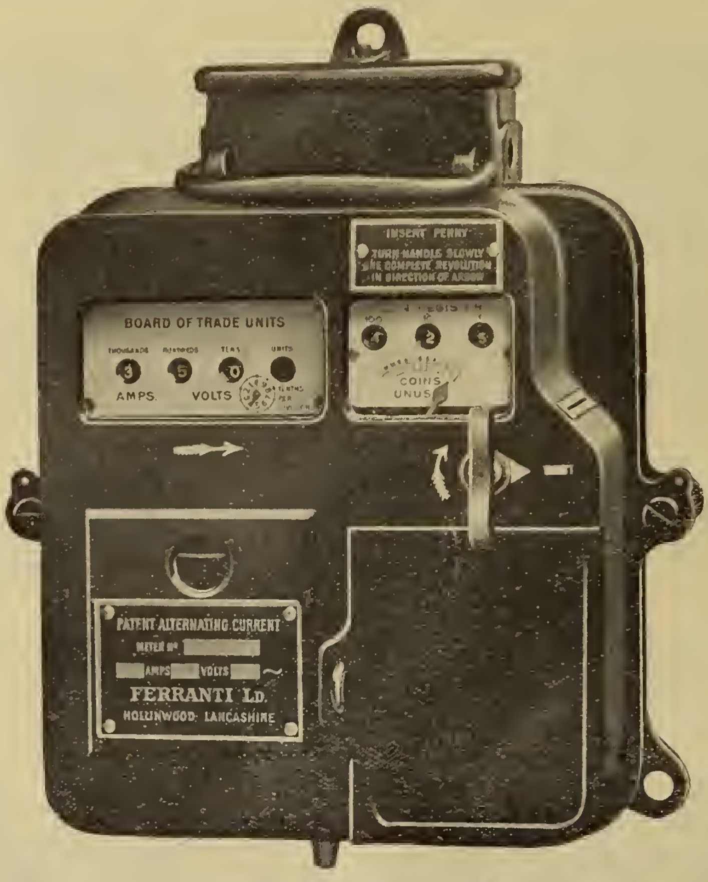
Benjamin Electric Mfg. Co.
of Canada, Limited
11-17 Charlotte Street - TORONTO

FERRANTI

PREPAYMENT METERS

Sell your current C. O. D.

Many people prefer to buy their electricity this way



Avoids disputes and dissatisfaction.

Eliminates bad accounts and does away with unpaid bills.

Impossible to operate by any fraudulant means.

Twenty-five cent coin used at any rate per K. W. hour.

Abolishes unnecessary accounting and billing.

Reliability and accuracy guaranteed for three years.

Made for potentials up to 250 volts and currents of 5 to 25 amps.

Send us a trial order.

EVERYTHING IN METERS

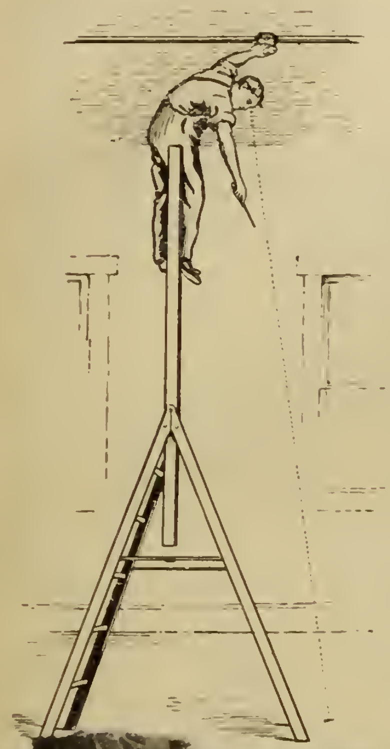
FERRANTI ELECTRICAL COMPANY OF CANADA LIMITED

90 Sherbourne St.
TORONTO

Farmer's Advocate Bldg.
WINNIPEG

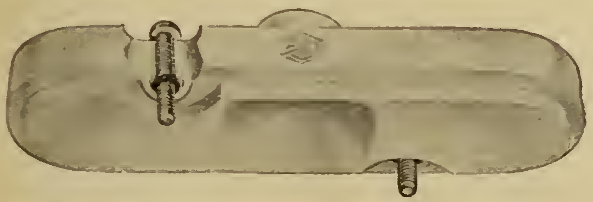
Screws That Can't Fall Out

Users of Condulets Lose No Time Picking Up Fastening Screws for Covers or Conduletto Fittings.



Couldn't Happen with a Condulet Cover

Brass Screws—the Proper Quantity, Size, Shape and Thread—are furnished with Condulet Covers and Conduletto Fittings, and are so secured in screw holes that they ***can't fall out.***



Screw for Porcelains

Screws for Porcelain Covers and Fittings are held in place by formed up fibre washers that engage the screw thread. Washer is put on after screw has been inserted in screw hole, and fits within cup made for it in the porcelain.

Screws for Metal Covers are necked just under the head, and screw holes in covers are tapped. When threading on screw has passed threading in hole, no shaking or knocks can make screw back out.

Screw for Metal Covers

NOTICE—This company has discontinued furnishing cover and fitting fastening screws with Condulets. These screws are now furnished with Condulet Covers and Conduletto Fittings for Condulets.

Crouse-Hinds Co. of Canada, Limited

Main Office and Works:

Toronto, Ontario, Canada

Announcement

THE business which has heretofore been carried on under the name of Kilmer, Pullen and Burnham, Limited, will be continued by The Swedish General Electric, Limited.

This change of name has been adopted as we think it conveys to the public a better idea of the business we are conducting. We are now better equipped than ever to take care of the ever increasing demand for Swedish Generators, Motors and electrical installations of all kinds. We have at present installations in Canada amounting to over 100,000 H.P.

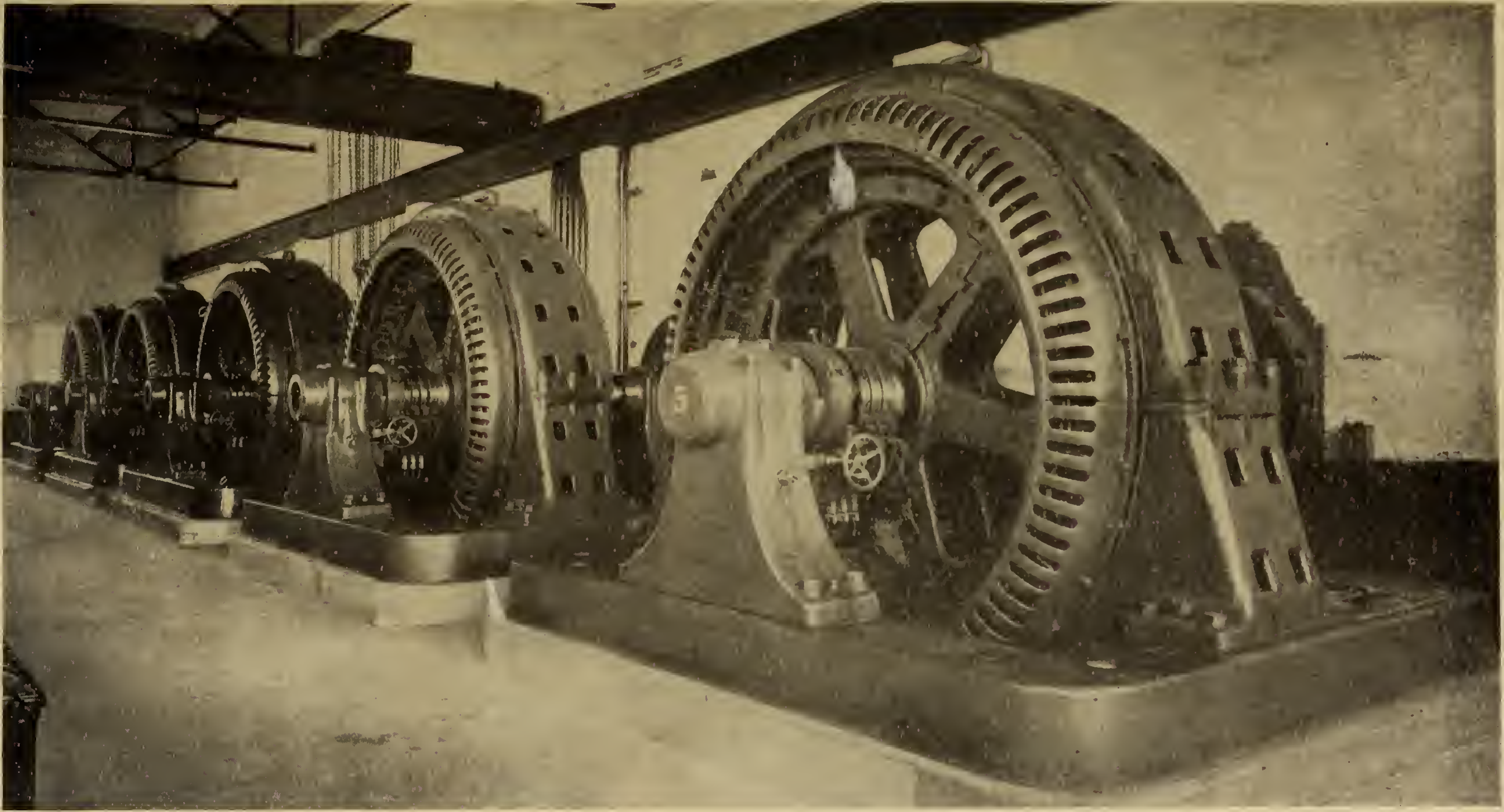
Our Head Office will be as formerly at Suite No. 1009 to 1012 Kent Building, Toronto, with Branch Offices at Montreal, Calgary and Vancouver.

We wish to take this opportunity of thanking our many friends for past favors, and trust with our increased facilities to so conduct our business as to merit a continuance of your patronage.

Swedish General Electric

Limited

Frank Pullen, President



The largest motor installation in Canada—Five 2,000 h.p., 12,000 volt, 25 cycle, 3 phase, 246 r. p. m. Swedish General Electric induction motors just installed by Messrs. Kilmer, Pullen & Burnham in the mills of the Ontario Paper Company, Thorold, Ont.

THE GENERAL ELECTRIC CO., OF SWEDEN

Sole Dealers for Canada

Kilmer, Pullen & Burnham, Limited
Head Office, TORONTO

Branch Offices: MONTREAL
General Supplies Ltd.,
CALGARY, ALTA.

ALPHABETICAL LIST OF ADVERTISERS

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The Best Endorsement of the value of the "Electrical News" as an advertising medium is the above List of Advertisers

Conduits Company Limited

Toronto - Montreal

Toronto General Hospital. "GALVADUCT" Buildings.

GALVADUCT

"GALVADUCT"

The most perfect interior construction conduit on the market.

Recognized as the standard of high quality.

Always specify Galvaduct or Loricated CONDUITS

These high class conduits are for use in every kind of building, as is shown by the many buildings that are equipped with **Galvaduct** and **Loricated.** They afford safe and lasting channels for wiring.

"LORICATED"

A high-class interior construction conduit of the enamelled type, proof against acid or other corrosive agents.

If your jobber cannot supply you—write us.

LORICATED

We Want To Share Something New and "Big" with You

We have just secured the Agency for a thing that fills a long felt and serious want—it is a simple, efficient and low priced system of fire protection. This System which is as easily adaptable to a small house, shed, or a large factory is called

AUTOMATIC FIRE DETECTOR

It has been tried and proven by us and many others and we know there is **big** money in it for the dealers who will handle it for us. It will be a valuable addition to your battery and bell department and its low price and reliability ensures large sales.

Speak to our travellers about it or write us direct for explanatory literature.

Chapman & Walker
Limited
Electrical Contractors
Richmond St. W., TORONTO

No. 21 Bulb, 50 C.P.

We are sole Canadian Agents for

"ROYAL EDISWAN"

CARBON FILAMENT LAMPS

In the manufacture of the "Royal Ediswan" Carbon Lamp, the makers have spared no effort to perfect a product of superior quality and maximum efficiency.

Those among your customers who prefer the carbon filament lamp will find the "Royal Ediswan" a satisfaction which comes only from a high-grade product.

Made in standard American bulbs, (also fancy bulbs) and built to standard specifications.

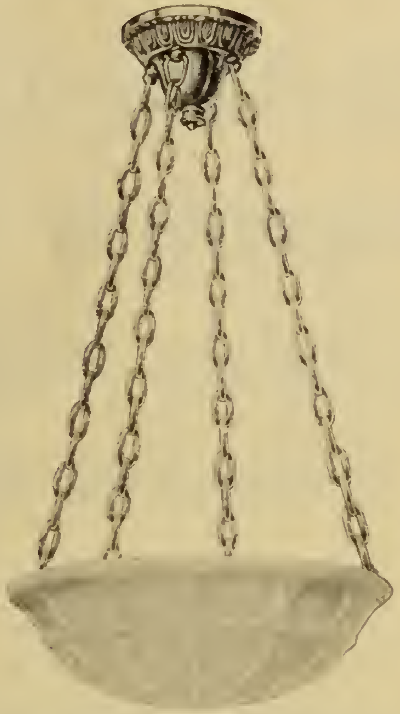
We are prepared to make prompt shipments on all orders—large or small.

Chapman & Walker, Limited
TORONTO 118-20 Richmond St. West ONTARIO
MONTREAL WINNIPEG VANCOUVER

01210 made in 8-10-12-14-16 and 18 inch diameter.

D R U I D

Another new one



01220 made in 12-16 and 20 inch diam.

Panelex designs (we furnish glass only)

G L A S S

Get samples now

01218 made in 8-12 and 16½ inch lengths.

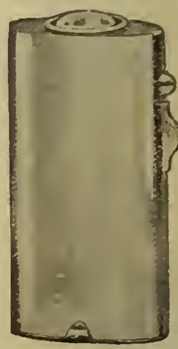
The Holophane Co., Limited, Toronto

OUR Best Wishes for a Happy and Prosperous New Year to our many friends who have made us the largest Electrical Supply House in the West.

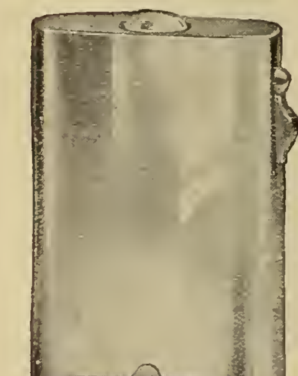
Mainer Electric Company, Limited

Winnipeg, Man. *Edmonton, Alta.*

Place Your Orders for Eveready Flashlights with Our Nearest House



This is a profitable line to carry. The popularity of portable Electric Lamps is increasing every day. Eveready Flashlights give satisfactory service under all conditions. They are equipped with the Eveready guaranteed Tungsten Battery and Mazda Bulb.



The complete stock carried at each of our branch houses insures prompt shipment on all orders.

You will be interested in our special dealers' proposition.

Write our nearest house for information.

THE Northern Electric AND MANUFACTURING CO. LIMITED

MONTREAL HALIFAX TORONTO WINNIPEG
REGINA CALGARY EDMONTON VANCOUVER VICTORIA

—of interest to Busy Men

When you wish to talk with your Secretary—Sales Manager or Superintendent do you have them come to you or do you go to them? Either method is a waste of time and effort. If you want to cut out this lost motion and increase the efficiency of your entire organization

Northern-Electric
Inter-phones

will solve the problem.

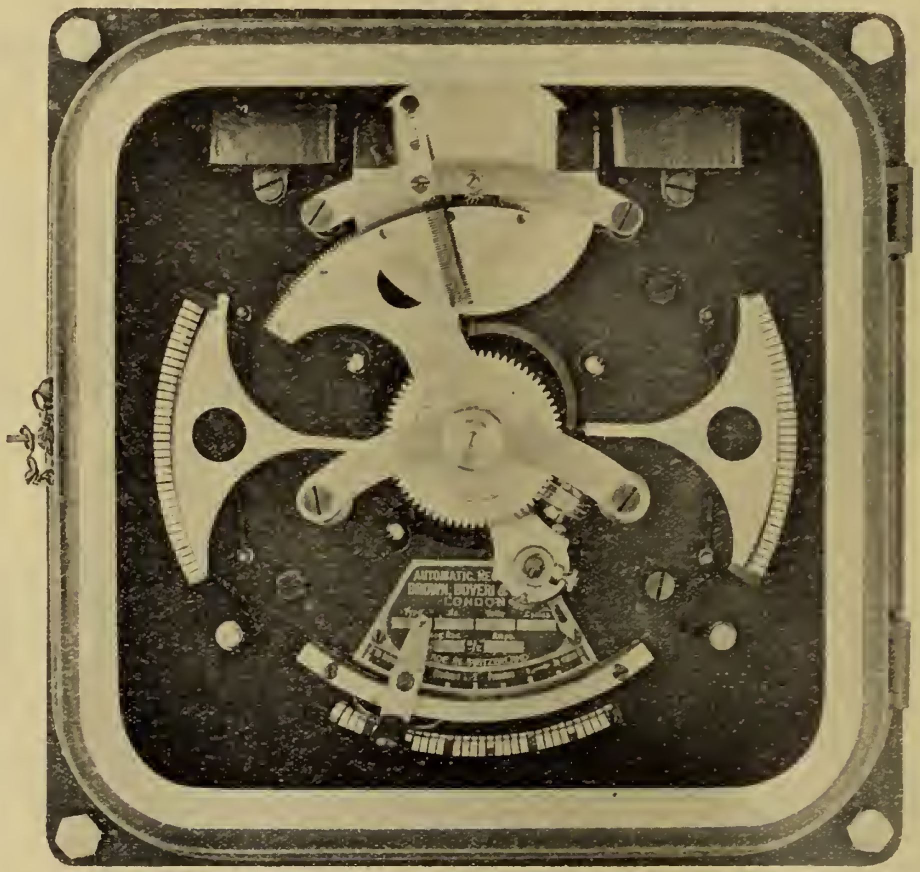
Without leaving your office you can converse with any or all of your department heads by simply pressing the proper key. Northern Electric Interphones are great time savers. They will enlarge your capacity for work and give you a better grip on your business. They will supplement your Private Branch Exchange.

Write our nearest house for information as to the system best adapted to your particular needs. This places you under no obligation.

THE Northern-Electric
AND MANUFACTURING CO. LIMITED
Makers of the Nation's Telephones

Montreal Halifax Toronto Winnipeg
Regina Calgary Edmonton Vancouver Victoria

BROWN BOVERI
AUTOMATIC VOLTAGE REGULATORS



Simple in Construction **Prompt in Action**

Accurate in Regulation **Reliable in Service**

Entirely without sliding or make and break contacts, and

Require No Attention

Thousands Already in Operation

THE CANADIAN CROCKER-WHEELER CO., LIMITED

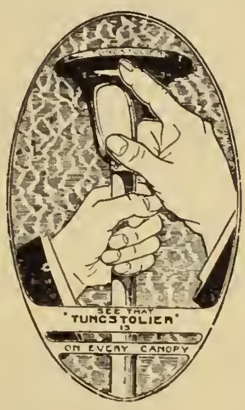
MANUFACTURERS AND ELECTRICAL ENGINEERS

Head Office and Works
ST. CATHARINES

District Offices
MONTREAL, TORONTO, VANCOUVER

START OFF RIGHT

1914


SEE THAT "TUNGSTOLIER" IS ON EVERY CANOPY

← TUNGSTOLIER →

TRADE MARKS

That Mean Honest Fixtures

That Mean The Best Designs **That Mean Real Value**

SELL TUNGSTOLIERS

The Tungstolier Company

Head Office and Sample Rooms, 4th Floor Canadian General Electric Bldg., Simcoe and King Sts., Toronto

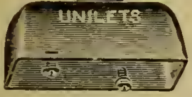
---

"UNILETS"

TRADE A MARK REGISTERED

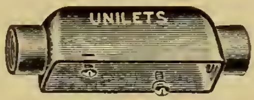
are drawn from steel and are light in weight, neat in appearance, and their durability cannot be surpassed. They are the ideal conduit fittings for up-to-date work and should be used by all contractors and those desiring their installations to be perfect in all respects. "UNILETS" are mechanically right. Furnished in either Black Enameled or Sherardized finished.

Rectangular Steel Unilets for ½" to 3" conduit inclusive



Cat. No. 9000

Cat. No. 9001



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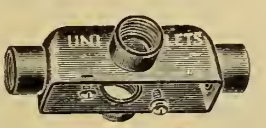
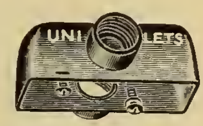
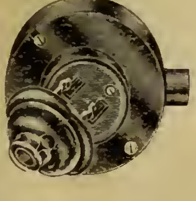


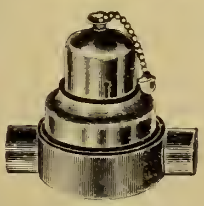
Cat. No. 9004



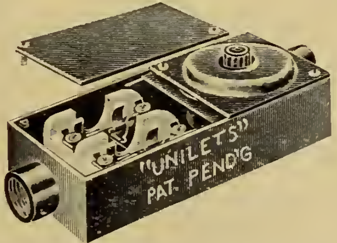
Cat. No. 9008



Type No. 1—4 inch Round Unilet with Two-phase Receptacle Attached.



Cat. No. 7402 Snap Switch Unilet with Hubbell No. 5795 Pull Switch Attached.



Combination Cut-Out and Snap Switch Unilet-Double Pole—250 volt.

Cat. No. 6906 Vapor-Proof Unilet.

Cat. No. 10 Service Entrance Unilet with No. 6003 Cover Attached.

Copy of booklet "UNILETS" sent on request

APPLETON ELECTRIC COMPANY

Main Office and Factory **CHICAGO** 212-214 N. Jefferson Street

For Sale in Canada by

The Mainer Electric Co., Ltd., Winnipeg Marshall-Wells Co., Ltd., Winnipeg Chapman & Walker, Ltd., Toronto

Yager's Soldering Fluxes

Either of our four forms produces the same result—a perfect **Electrical** joint, tight, free from corrosion. **Yager's** Fluxes are non-acid and have proven absolutely efficient for 35 years of use. Test them at our expense and send us that order, or your jobber's name.

ALEX. R. BENSON CO.

HUDSON, N.Y.

Goods manufactured by

The Canada Metal Co., Limited

Have a Reputation for Quality

IMPERIAL SOLDERING PASTE

Absolutely the finest soldering paste on the market.

IN TINS
2 oz.
4 oz.

IN TINS
8 oz.
1 oz.

THE CANADA METAL CO LIMITED
MONTREAL
TORONTO
WINNIPEG
TRADE
MARK REGD.
IMPERIAL
SOLDERING
PASTE
FOR PLUMBING, ELECTRICAL AND GENERAL SOLDERING

A Sample Order will convince you that we have reason to be proud of the goods we manufacture.

We have 5,000 2 oz. tins to give away as free samples. Send us your name and address to-day and receive one *Post Paid.*

Manufactured by

The CANADA METAL CO., Limited

TORONTO

Branch Factories: MONTREAL and WINNIPEG

SIMPLEX QUALITY

The Year-Round Merits of Simplex Products make our Holiday Offerings Self-Sellers.

You can't well overstock on Simplex goods—they are always first choice.

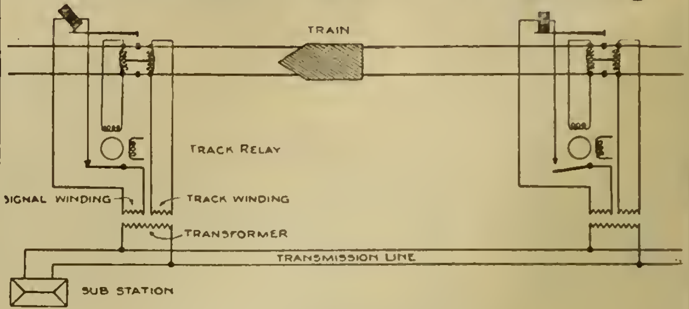
We have greatly enlarged our popular Simplex line with new offerings of specially attractive lamp socket devices. They give you a nice profit margin, and have a strong selling appeal. Special holiday packing.

Descriptive Matter is Now Ready

SIMPLEX ELECTRIC HEATING CO.

Mfrs. of Everything for Electric Heating and Cooking
BELLEVILLE, ONT.
CHICAGO, 15 S. Desplaines St. CAMBRIDGE, MASS.
SAN FRANCISCO, 612 Howard St.

Consider the Fundamentals of Continuous Track Circuit Signaling



In G. R. S. Block Signals

The principle is simplicity itself. The track circuit is merely an electric circuit of which the rails form a part. The positive and negative sides of the supply of Electrical Energy are connected to the rails at one end of the track section, and the relay across the rails at the other end of the section. It will be seen that with no train in the section the relay will be picked up, and, that ed across the track, thereby causing the relay to drop. The relays, through the contacts with which they are equipped controls the supply of current to the signal. The word **continuous** is introduced because, in the G. R. S. system, the circuits extend the entire length of the block.

Continuous Track Circuit Signaling is the simplest system that can be depended upon for correct signal indications under all conceivable conditions. The system as applied to G. R. S. Block Signals, embodies the highest development which all railway experience has produced.

A line of inquiry brings you the details of many electric railway installations.

"Safety First"

GENERAL RAILWAY SIGNAL COMPANY
OF CANADA LIMITED

Office and Works, Lachine, Quebec Branch Office, Winnipeg, Manitoba

9086A

Tenders Wanted

should be advertised for in the "Tenders and For Sale Department" of the CONTRACT RECORD AND ENGINEERING REVIEW. This paper is the "Tender Ad." medium of Canada and always brings bids from the reliable contractors and supply houses.

File your plans for any work on which you are inviting bids, in our offices at Toronto, Montreal, Winnipeg or Vancouver.

Contract Record and Engineering Review

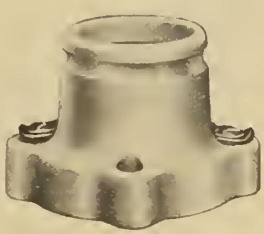
Toronto Ontario

Duncan Receptacles

Guaranteed by this

TRADE DUNCAN MARK

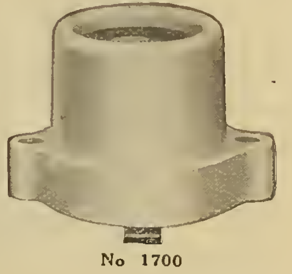
No. 9171
(¾ Actual Size)


No. 4013
(¾ Actual Size)

Edison Cleat Receptacles

These receptacles meet every requirement of the underwriters for temporary work. Stalwart in construction, they stand a lot of hard usage.

No, 29
(½ Actual Size)


No 1700
(¾ Actual Size)

Sign Receptacles

There are no better receptacles than these. No. 29 is a self holding receptacle which may be used in a round hole without notches or side holes,—a great convenience. No. 1700 is our Pony Sign Receptacle, Nos. 877 and 988 are two piece Receptacles.

No. 988
(¾ Actual Size)

No. 877
(¾ Actual Size)

ORDER THROUGH YOUR JOBBER

The Duncan Electrical Co., Limited

Montreal

Packard

The Meter with a Reputation

Type "K" Meter

Meter with Glass Case giving clear view of interior mechanism.

Meter without case, showing improved magnet support and light load adjustment.

Large Stocks Carried at

St. Catherines and Winnipeg; St. John Railway Co., St. John, N. B.; General Supplies, Limited, Calgary, Alta.; Rudel-Belnap Machinery Co., Canadian Express Bldg., Montreal, P. Q.

The Packard Electric Co., Limited

Factory at St. Catharines, Ont.

General Sales Office,
Traders Bank Bldg., TORONTO

N. W. Office and Warerooms
WINNIPEG

A Gradual Elimination

of the various makes of carbon brushes on the market, with due consideration for their particular and distinctive merits, would result in the choice of

LE CARBONE Brushes

(Made in France)

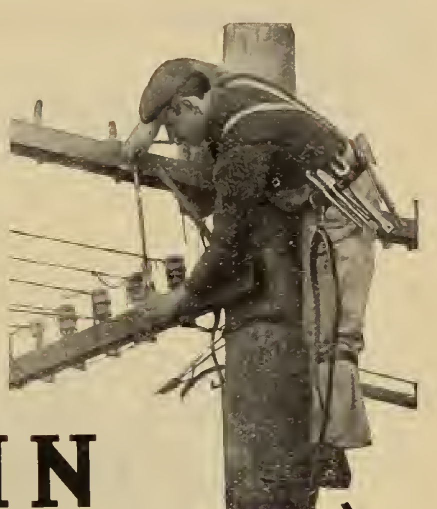
They bring down the yearly brush cost—increase car mileage—eliminate commutator wear—and reduce Armature room expenses.

" Le Carbone " brushes furnished in each grade are absolutely uniform as to their mechanical and electrical characteristics.

WRITE FOR BOOKLET

Rougier Freres, Incorporated
63 Notre Dame East, MONTREAL

The
Wise
Lineman
Always
Asks
For



KLEIN TOOLS

because he knows that he can trust his life and his job to " **KLEIN TOOLS.**" He's not always so sure about other tools. It isn't a question of cost with the lineman. It's trustworthy equipment he wants and must have. That's why he says " **KLEIN** " when he asks for tools. Klein Tools cost a little more than the other kind, but there's a good reason for it. There's a profitable hint in this for dealers. Write for our display sign, hang it out, and watch your business increase.

WRITE FOR ILLUSTRATED CATALOG

MATHIAS KLEIN & SONS
Canal Station 59 - - CHICAGO

A SILCOR TUMBLE

Beats The Balls Buffer, Sand Blast

And all other devices for polishing

THE HIGHEST AND CHEAPEST LUSTRE AND IN EVERY TINY CORNER

TENDER WITH THE MOST DELICATE BUT CUTS THE HARDEST STEEL
BRASS, NICKEL, CAST IRON, GERMAN SILVER, STEEL—ANY METAL

Small Plants—Five dollars' worth of "SILCOR" and an improvised barrel will save most all that hand labor.
Large Plants—Dispense with hand labor and roll both tiny and huge pieces in "SILCOR."
Holding a piece to a buffer is as illogical as turning the buffer by hand. Let the Power roll it in "SILCOR." "SILCOR" will find every spot.
It costs so little to polish by tumbling with "SILCOR" that no piece ought to leave your plant unpolished.
Send 10c and parcel postage for sample pound and shake some of your pieces in a tin can. Then send for a barrel load.

Corundum Products Company
Spokane, Washington, U. S. A.

The Canadian Porcelain Company, Limited

HAMILTON, - ONTARIO

Cut shows new plant recently completed and now in operation.

We wish to announce our readiness to tender on your insulator requirements.

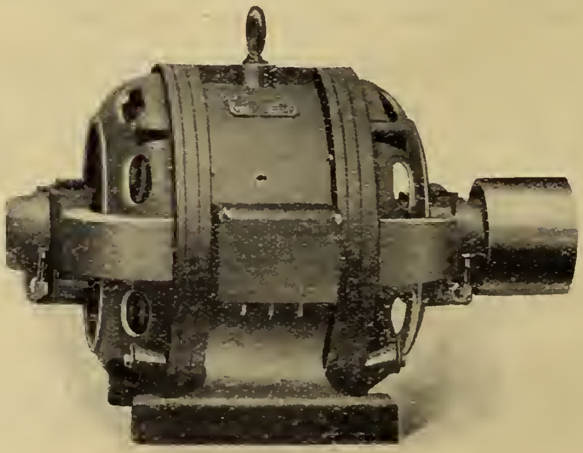
Our plant is modern in every respect embodying the best European and American practice in arrangement and methods.

Our plant is in charge of experienced insulator specialists.

"UNION" MOTORS.

Write for our general stock list.

Large stock carried at main distributing points throughout Canada.

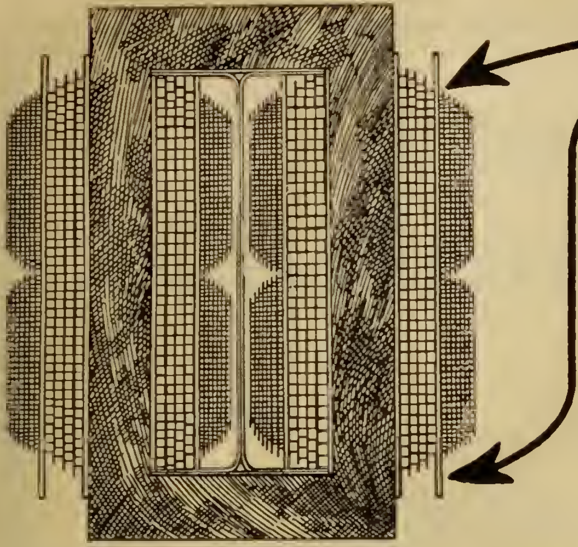


Pattern H.D. Squirrel cage motor.

When in a hurry for a motor take advantage of our "rush-order" service.

Canadian Union Electric Co., Limited
Head Office: 130 Wellington St., West, Toronto
Also at 9 St. Nicholas St., Montreal

Represented in Winnipeg by:
The Mainer Electric Co., Limited
61-63 Albert St.



Moloney

High Insulation

A FEATURE of vital importance to the economical operation and upkeep of a transformer is the insulation. It must be the best quality material applied in the most efficient manner.

The illustration shows a sectional view of a Moloney type H. E. transformer. Note the manner in which the insulation between the primary and secondary extends beyond the end of the coils, also the insulation between the primary layers extending beyond the outside turns.

Moloney transformers are the best in every detail of design and workmanship.

Our Catalogue contains much valuable information

Canadian Moloney Electric Co., Limited

WINDSOR, ONTARIO

Factories at Windsor, Ont. and St. Louis, Mo., U.S.A.

825 Vancouver Block, Vancouver, B. C. Canada
901 New Electric Railway Chamber, Winnipeg, Man., Canada
1001 C. P. R. Building, Toronto, Ont., Canada

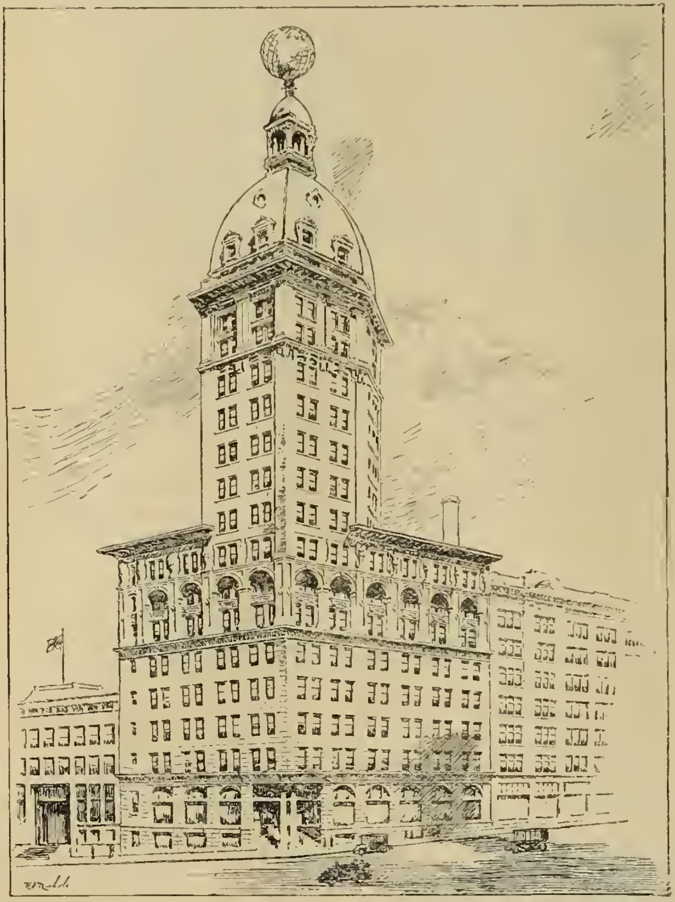
Complete Stocks at **Windsor, Winnipeg, Vancouver**

Across Canada with the

IMPERIAL WIRE & CABLE CO.

LIMITED

Toronto - MONTREAL - Winnipeg



Seventh of a series of advertisements showing buildings of national importance which have been wired with the Imperial Wire & Cable Co.'s, Limited, wires.

This picture shows the World Building, Vancouver.

This building was wired with "Adanac" Rubber Insulated Wire

Architect - - - -	W. T. Whiteway, Vancouver
Engineer - - - -	W. E. Hughes, Vancouver
Electrical Contractor - -	J. G. Sutton, San Francisco, Cal.

Address enquiries to nearest office—Montreal—Toronto—Winnipeg

Enquiries from Alberta and British Columbia may be addressed to Northern Electric & Manufacturing Co., Limited, Calgary and Vancouver.

"ADANAC," "IMPERIAL HIGRADE" and "30% PARA"

G. M. Gest

Conduit
Engineer & Contractor

503 Power Building, Montreal, Can.

NEWTYPE
BERGMANN LAMPS

(Tungsten Filament)

The Unbreakable Kind

Are Now Ready for Delivery

We guarantee delivery to you in good condition

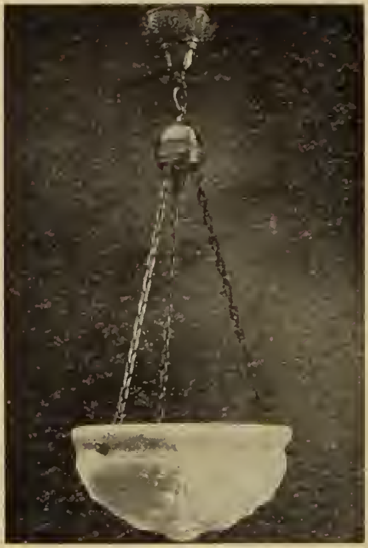
EXCLUSIVE CANADIAN DISTRIBUTORS

P. H. KLEIN CO.,
LIMITED

23-25 DOWD STREET,
MONTREAL, P.Q.

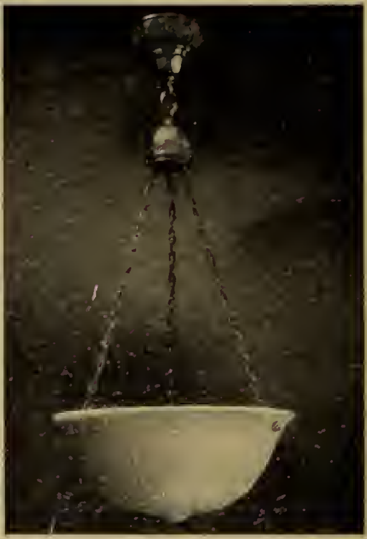
LIVE AGENTS WANTED ALL OVER CANADA

Parian Glassware

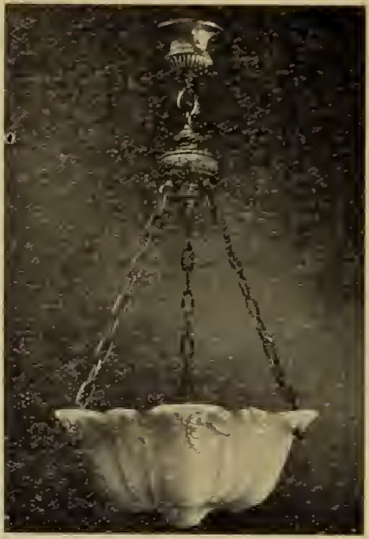


Dresden Bowl

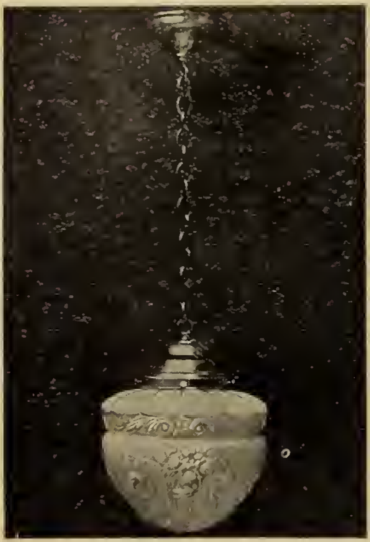
Unique and beautiful designs in illuminating Glassware, Bowls, Pendants—



Grecian Bowl

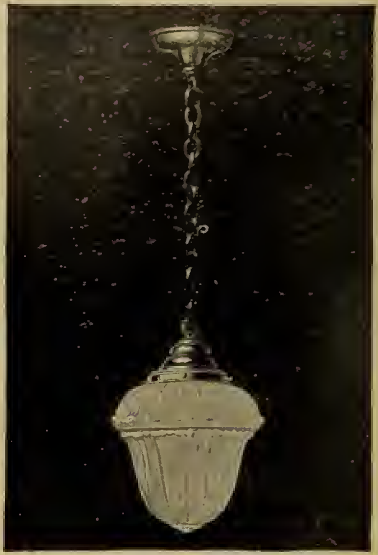


Louis XV. Bowl



Rococo Acorn

Spheres, Hemispheres, etc. All in Parian Glass, the pure white color and finish of Parian marble.



Classic Acorn

CANADIAN GENERAL ELECTRIC CO.

LIMITED

Head Office: TORONTO

District Sales Offices: Montreal, Halifax, Ottawa, Cobalt, Porcupine, Fort William, Winnipeg, Regina, Saskatoon, Calgary, Edmonton, Nelson, Vancouver, Victoria, Prince Rupert

CUTLER-HAMMER

Elevator Controllers

The absolute safety that is insured by the Cutler-Hammer Bulletin 7560 Elevator Controller is of most vital importance to-day, because of the many thousands of people carried daily in passenger elevators.

The control system is so laid out that even should grounds or short circuits occur in the elevator cables or switches, no damage can result. No one has yet invented a cable that will never wear out, but the Cutler-Hammer control system eliminates any danger resulting from such failures.

Maximum Safety and Every Refinement of Control

that can be used in connection with direct current motors are provided by the Bulletin 7560 type controller illustrated below.

The operation is very quiet, the contracts are all of the vertical butt "type," carbon to copper, with a wide range of adjustments for taking up wear and giving a long life. Being vertical, dust and dirt does not collect on them.

The Important Features are:

1. Safety.
2. Refinement of control.
3. Quiet operation.
4. Main line magnetic switch is double-pole, breaking both sides of the line.
5. Vertical "butt" carbon to copper contacts insure long service and do not collect dust or dirt.
6. All parts and connections accessible.
7. Rugged construction.
8. Overload device automatically reset by throwing car switch to off position, making it possible to set this overload within the closest limits.

Controllers for all Types of Elevators

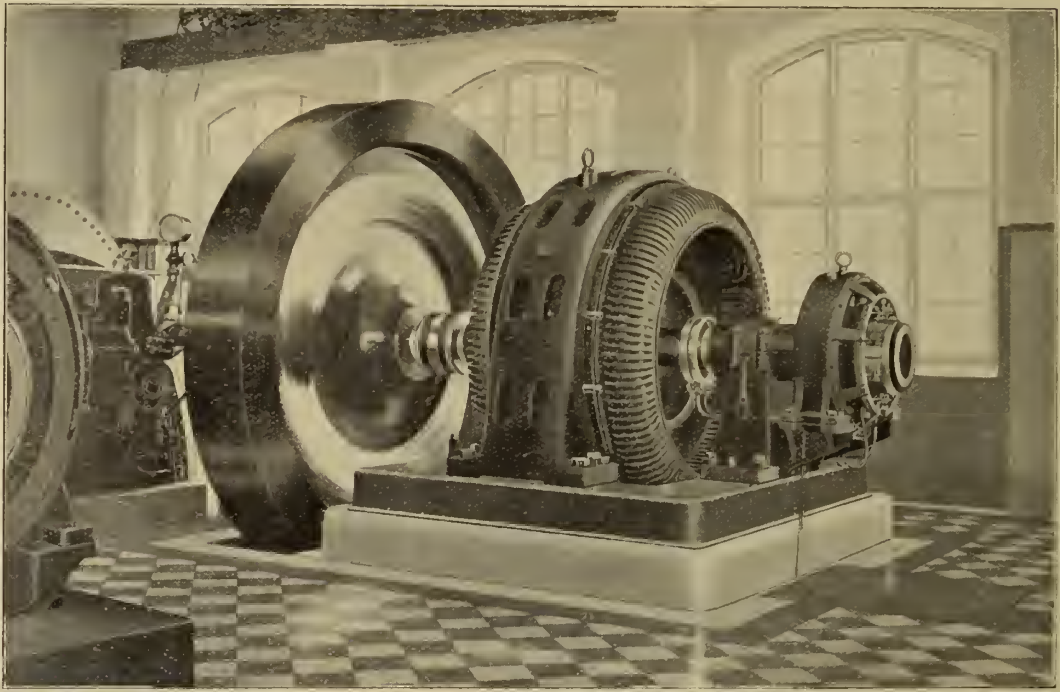
are made, including those for heavy freight and those of the highest speed passenger type.

Booklet containing complete set of Elevator Bulletins sent to those interested.

THE CUTLER-HAMMER MFG. CO. MILWAUKEE

NEW YORK: Hudson Terminal 50 Church Street CHICAGO: Peoples Gas Bldg. PITTSBURG: Farmers' Bank Building
BOSTON: Columbian Life Bldg. PHILADELPHIA: 1201 Chestnut Street CLEVELAND: Schofield Building
PACIFIC COAST AGENTS: H. B. Squires Co., 579 Howard St., SAN FRANCISCO, 229 Sherlock Building, PORTLAND, ORE.
and W. B. Palmer, 416 East 3rd St., LOS ANGELES.

Swedish Electrical Machinery
Noted for
Efficiency and Workmanship



860 K.V. A. 3 phase, 60 cycle, 400 R. P. M., 11500 volt water wheel driven Generator with direct connected exciter.

We solicit your specifications for Electrical Equipment

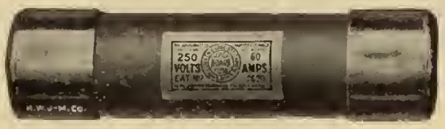
BURNHAM ENGINEERING COMPANY
LIMITED

Canadian Dealers for
The Amalgamated Electric Company of Sweden

Head Office:
Traders Bank Building,
TORONTO

Montreal Representatives:
Rudel Belnap Machinery Co., Ltd.
Canadian Express Bldg.

IDEAL PROTECTION FOR YOUR APPARATUS, WIRES AND CABLES



"NOARK" Enclosed Fuses insure protection against loss or damage whenever there is danger from short circuits or overloads.

"NOARK" ENCLOSED FUSES

are absolutely reliable, automatically indicate when blown, and, being "National Standard," are interchangeable.

Write nearest Branch for Booklet

THE CANADIAN H. W. JOHNS-MANVILLE CO., LIMITED

Manufacturers of
Asbestos and
Magnesia Products

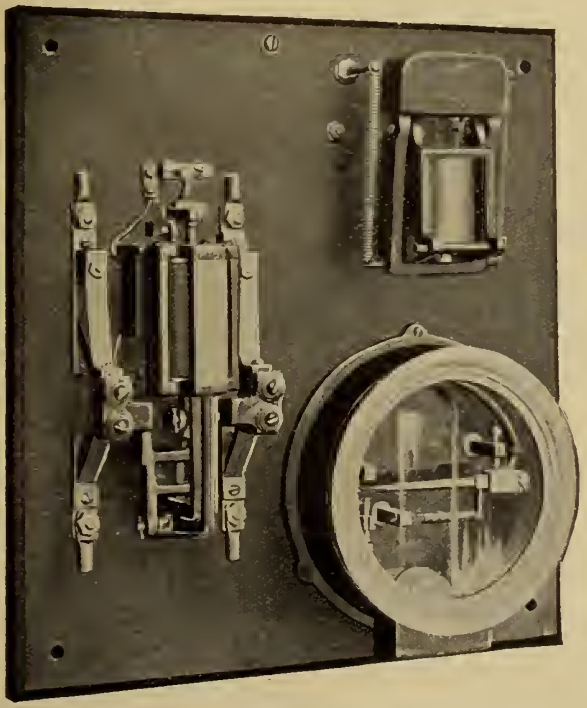
ASBESTOS

Asbestos Roofings,
Packings, Electrical
Supplies, Etc.

J-P.Co. REG. U.S. NOARK PAT. OFF. FUSE

TORONTO MONTREAL WINNIPEG VANCOUVER 1678

SUNDH PRESSURE REGULATORS



For use in starting A. C. and small D. C. Motors.

Specially designed for installations where they can be thrown across the line without the use of starting resistance. Compact and reliable and will not get out of order.

When the amperes taken by motor exceed the 10 amp. capacity of the magnet switch, a switch of large capacity is added, the magnet switch acting as a relay.

We manufacture a complete line of controlling devices, such as Motor Starters, Pressure Regulators, Tank and Sump Switches, Panels, etc.

Send for Catalogue.

Sundh Electric Company - - New York, U.S.A.

New Mode

Rubber Covered WIRES AND CABLES

Manufactured in accordance with the specifications of the National Board of Fire Underwriters.

SPECIFY CANADA BRAND

All our new code wire is inspected by the Underwriters Laboratories, Inc., and have their inspection tags attached.

Price list and discounts on application to head office or nearest agent.

Large stock, from which we can make prompt shipments, carried at Toronto, Montreal, Winnipeg and Vancouver.

Canada
Wire & Cable Co., Limited
1160-1170 Dundas Street
Toronto, - Canada

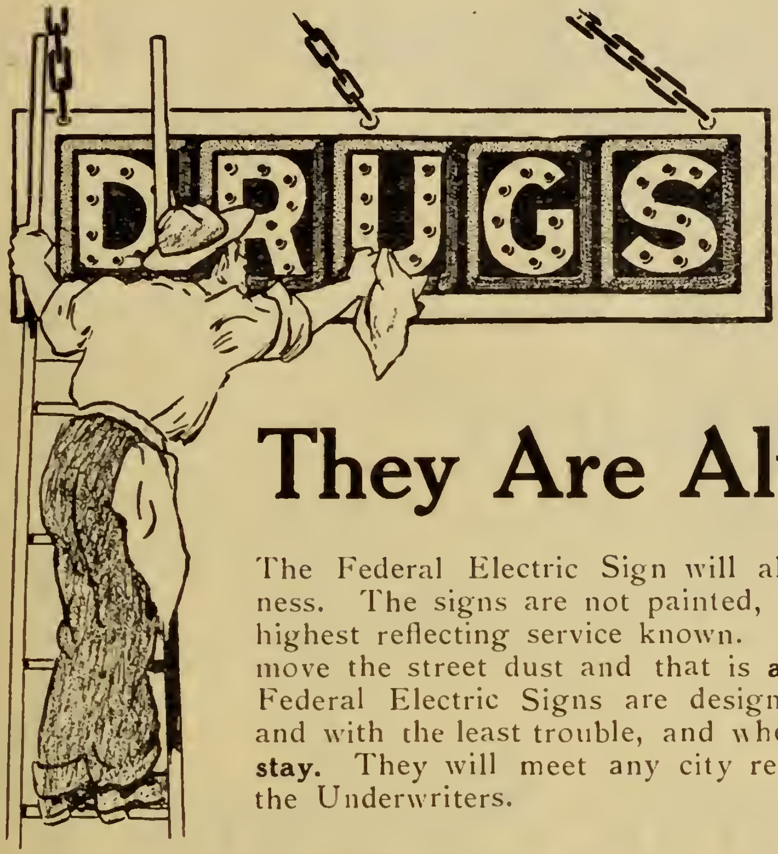
Sales Agents:

Roper, Clarke & Co., Limited
Montreal

A. E. Esling, Scott Block
Winnipeg

Macdonald, Marpole Co., Limited
Vancouver

Messrs. Gorman, Clancey & Grindley,
Calgary and Edmonton, Limited



Federal Electric Signs

They Are Always Bright

The Federal Electric Sign will always retain its original brightness. The signs are not painted, but are porcelain enameled, the highest reflecting service known. A little soap and water will remove the street dust and that is **all** the attention they ever need. Federal Electric Signs are designed to go up in the least time and with the least trouble, and when they are up, they are there to **stay.** They will meet any city regulations and are approved by the Underwriters.

An All Metal Sign That Will Last a Lifetime

The Federal Electric Sign is the result of painstaking planning and construction. It will withstand fire and water and will not rust. The frame is of galvanized channel iron and the sectional plates are stamped upon heavy sheet steel. It is practically indestructible.

Standard colors are a brilliant white upon a royal blue background, making a sign that is effective and attractive by day or night. The colors are porcelain enameled upon sheet steel and will never lose their brilliancy.

Central Stations Managers will find profit in the Federal.
Bulletin No. 27111 will be mailed upon request.
All Federal Signs sold F.O.B., Factory, Hamilton, Ont.

Federal Sign System (Electric)

Lake and Desplaines Streets
CHICAGO, ILLINOIS

Wagner, Quality

THE
STERLING MARK
IN THE
ELECTRICAL
WORLD

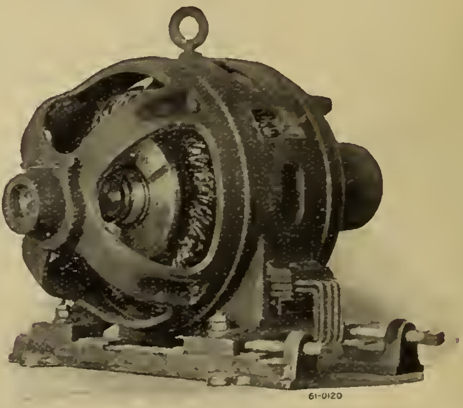
"Progressive"

That is the word that characterizes the Wagner Company, because of their large number of new and important contributions to the art of alternating current motor building.

One of particular importance is the self-starting polyphase motor, popularly named by the Wagner Company,

'The Public Servant'

because of its simplicity of control and its reliability.



The motor is started by simply closing a switch, and has sufficient torque to start under full load, without abnormally heavy current demands. Its running characteristics are those of the usual wound rotor type motor.

The use of this motor solves your remote control problems and materially simplifies them. The motor may be at a considerable distance from the starting switch. The attendant closes the switch to start the motor and opens it to stop motor.

If the line voltage fails the motor automatically returns to the starting position, so that it automatically starts when line voltage is re-established.
Think of the complicated device necessary to affect the same service when ordinary motors are used.

Which motor do you prefer? ***Bulletin 9513 gives details.***

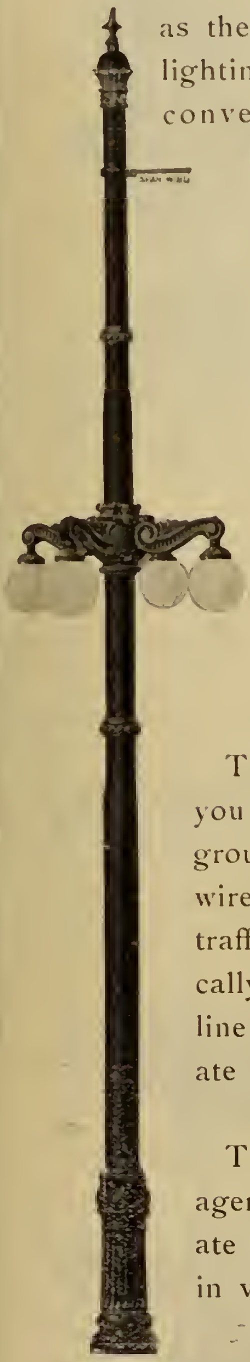
Wagner Electric Manufacturing Company

of Canada Limited—Montreal

Member of the Society for Electrical Development—Do it electrically.

2262

Use the Railway's Trolley Poles



as the basis of your new street lighting system. You can easily convert them into attractive Mazda Lamp Standards or arc lamp supports by use of

ERECO Combination Railway Lighting Pole Fixtures

This system, besides saving you the expense of underground construction, gets the wires up out of the way of traffic, where they are practically unnoticeable and the curb line is not crowded with separate lighting standards.

The progressive railway management will gladly co-operate with you with this object in view.

Design No. 10015.

Electric Railway Equipment Co.

Cincinnati, Ohio

Designers **Manufacturers**

Canadian Representatives:

Dawson & Co., Limited, Montreal, Winnipeg

N. Y. Office, 30 Church St., Hudson Terminal Bldg.

Butler Bros *Chicago*

Another Mammoth Firm Installs the Eye Comfort Lighting System.

Indirect Illumination is the light of the future. It is here to stay.

Many contractors and supply men realize this opportunity and are making big profits as a result. Central Stations are quick to grasp its advantages.

Which is then the most efficient and most economical system? Which is scientifically designed by engineers to produce perfect lighting, and which has been marketed merely to get some of the profits to be made by selling unscientific and inefficient equipment to a public who has not the knowledge to judge intelligently?

Which system shall **you** advocate?

We say to you:—

That the Eye Comfort Lighting System was installed by the Curtis Publishing Company at Philadelphia (1,000 fixtures) after a sixteen months' investigation. Armour & Company equipped their entire five-storey building (900 fixtures) after eight months of testing. Butler Brothers, shown above, light their offices and sample rooms (1,700 fixtures). Boys High School, New Orleans, is installing 1,200 fixtures. The world's largest men's wear store, The Hub, Chicago, is lighted by it throughout (eight stories). The International Harvester Co. has installed 350 fixtures; Sears Roebuck & Co., 700; Montgomery, Ward & Co., 250; Goodyear Tire & Rubber Co., 385 fixtures at Akron, besides thirty branches; and so on.

Millions of capital says "it is the best system, barring none!" This after exhaustive tests costing thousands and much time.

We cannot offer you stronger proof. We know of no more positive proof you can give your customers. Acquaint yourself with the Eye Comfort Lighting System. It is sold by Canadian jobbers. Ask for our data book and catalogue.

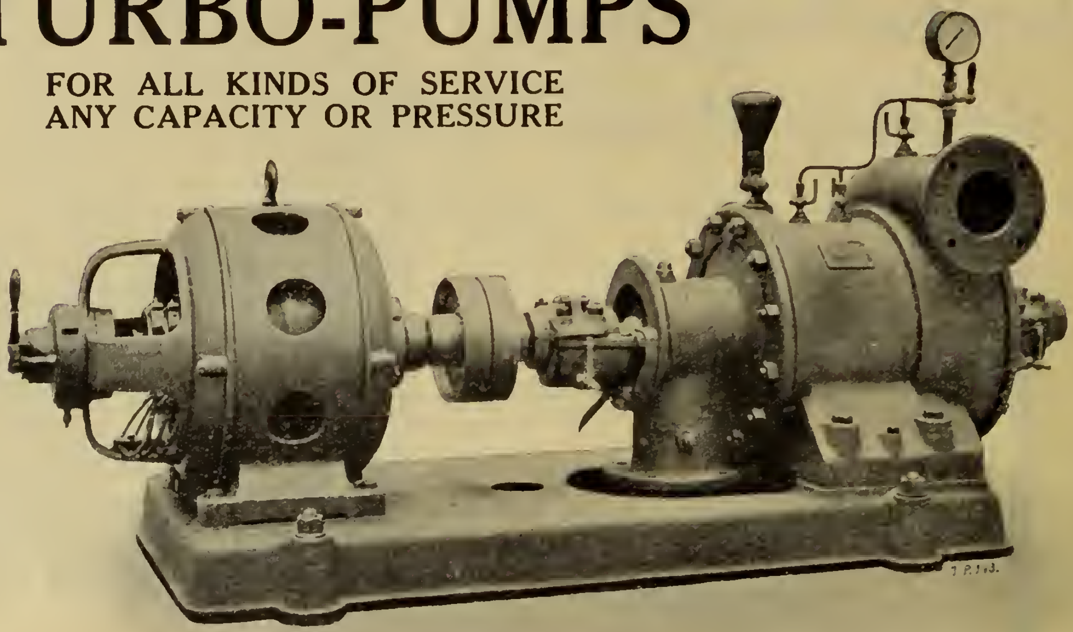
National X-Ray Reflector Co.

General Offices:
225 W. Jackson Blvd.
Chicago, Ill.

New York Office:
Eye Comfort Lighting Shop
14 W. 33rd. St.

TURBO-PUMPS

FOR ALL KINDS OF SERVICE
ANY CAPACITY OR PRESSURE



Highest Efficiency

Greatest Reliability

ESCHER WYSS & CO.

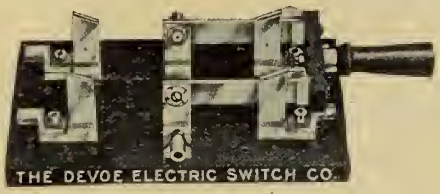
HEAD OFFICE FOR CANADA:
626-627 Coristine Bldg., Montreal, Que.

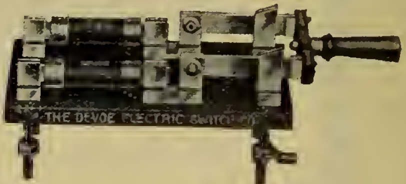
The Devoe Electric Switch Company

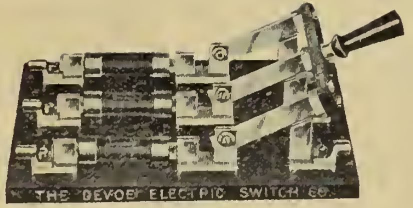
MANUFACTURERS

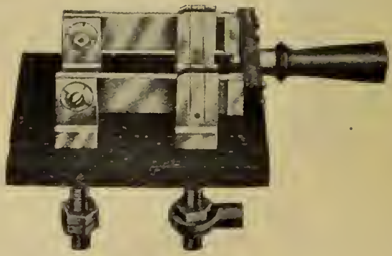
We design and manufacture SWITCHBOARDS, PANELBOARDS, CABINETS, SWITCHES and IRON BOXES of every description.

Quotations promptly made upon request when drawing or sufficient data are submitted.







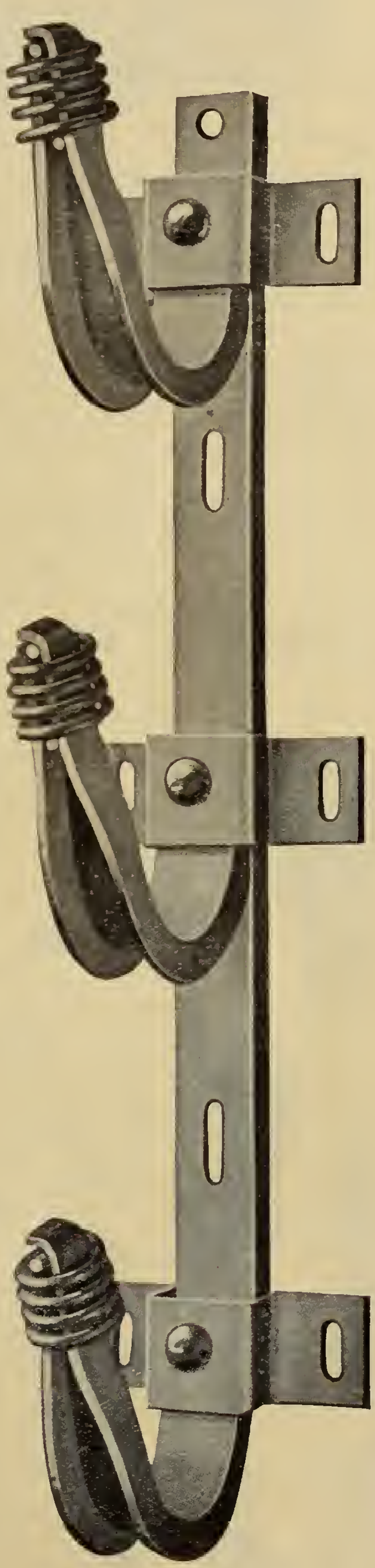


Write for Switch Catalogue No. 6 and Box Bulletin No. 2.

Send us your Specifications.

Office and Factory: No. 157 Craig St. West, Montreal
Frank G. Scofield, Ontario Sales Representative, Lumsden Building, Toronto, Ontario

This Big, Husky Bracket Used to be a Specialty: It's a Tonnage Proposition Now



because dozens and scores of Central Stations are finding out that it is a real money saver in service as compared with the common or garden variety that was born with the telegraph and never grew up.

The wide base of this bracket is formed by a broad steel strap, securely riveted to both the pin and the backbone.

The pins and the backbone are made of **channel** section, **hot-rolled** open hearth steel, of extremely liberal dimensions. Channel steel construction originated in the Peirce Line.

Slots in the base straps, permit the use of additional bolts or spikes to anchor the bracket, the straps acting as levers and making it impossible for the bracket to roll over under severe strains.

The whole bracket—base straps, backbone, pins and rivets—is heavily galvanized by the hot dip process, which defers corrosion indefinitely.

Peirce specialties and Hubbard line hardware are carried by Canadian Electrical jobbers.

The Hardware MAKES the Line, Hubbard Makes THE Hardware

Hubbard and Company,

Pittsburgh, U.S.A.

"Look for the Gray Shell"

Light and Power Companies, Large Corporations, Industrial Plants, Mining and Smelting Companies, Department Stores, Hotels, Office Buildings, Electric and Steam Railroads, Steamships, U. S. Government, and many other classes of users are reducing fuse Maintenance expense over 80 per cent by using

ECONOMY RENEWABLE FUSES

They use Economy Renewable Fuses for these reasons:

First, of course, because it provides a practical method of reducing the fuse maintenance expense more than 80%.
Second, because it is the only renewable fuse that is uniformly rated.
Third, because it is the only design so far produced that provides the desired electrical characteristics.
Fourth, because all capacities of renewal elements are readily available, making large fuse stocks unnecessary.
Fifth, because they never vent fire or hold a sustained arc and are absolutely safe.
Sixth, because they meet the performance specifications governing the use of such devices.

Special Announcement!

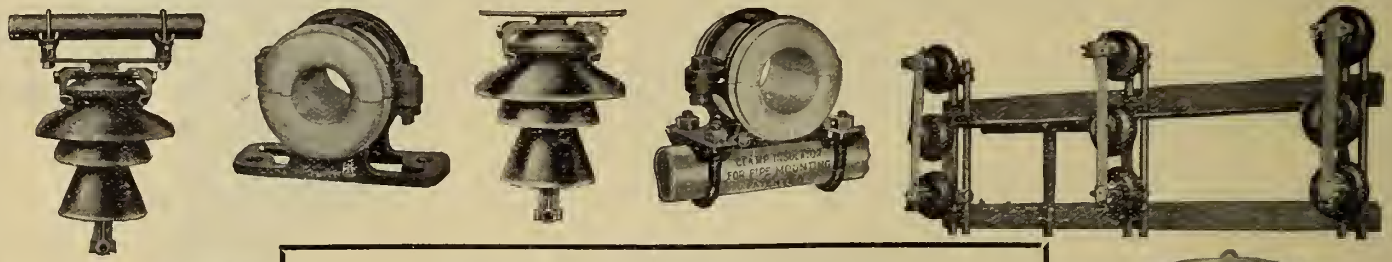
Two Economy Renewal Elements are now furnished (without charge) with each Economy Fuse. Now YOU figure what fuse is the cheapest not only to buy but also to maintain.

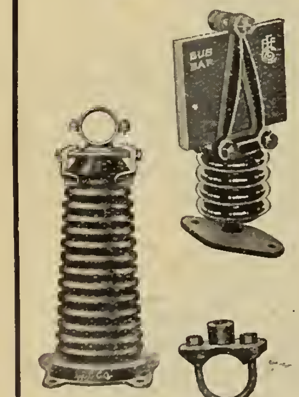
Write for Bulletin, Prices and Discounts

Economy Fuse & Mfg. Co. of Canada, Limited

Herald Building, Montreal

ECONOMY Renewable Fuses are sanctioned by the Canadian Fire Underwriters' Association.





INVESTIGATION PAYS

especially in the use of central-station and transmission specialties. We court the most rigid investigation of our devices.

Outdoor Pole Top and Station Disconnecting Switches in all capacities and voltages, Bus Bar Supports, Cable End Bells, Switchboard and Pipe Frame Fittings, Inverted Suspension Supports for both pipe and flat mounting, Clamp Insulators, Station Pins and other Station and Transmission Specialties.

Suitable designs for any special conditions. You are assured of our responsibility by our Five-Year Guarantee.

Send for our Blue Catalogue and Pole Top Switch Bulletin 100.

ELECTRICAL ENGINEERS EQUIPMENT CO.

10-12 N. Desplaines Street Chicago, Ill

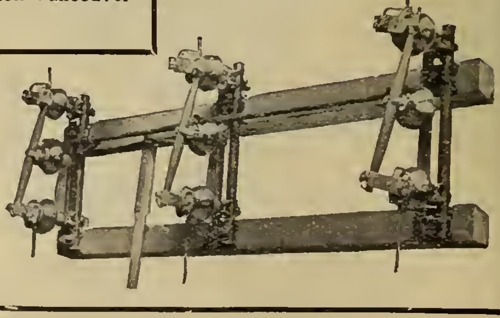
Canadian Distributors:

Montreal Halifax Regina Calgary

The Northern-Electric and Manufacturing Co Limited

Toronto Winnipeg Edmonton Vancouver

Western Electric Co., Distributors.



Electrical News
Generation, Transmission and Application of Electricity

Published Semi-Monthly By
HUGH C. MacLEAN, LIMITED,
HUGH C. MacLEAN, Winnipeg, President.
THOMAS S. YOUNG, General Manager.

HEAD OFFICE - - 220 King Street West, TORONTO
Telephone A. 929

MONTREAL - Telephone Main 2299 - 119 Board of Trade
WINNIPEG - Telephone Garry 856 - 302 Travellers' Bldg.
VANCOUVER - Tel. Seymour 2013 - Hutchison Block
NEW YORK - Tel. 3108 Beekman - 931 Tribune Building
CHICAGO - Tel. Randolph 6018 - 659 Peoples Gas Bldg.
LONDON, ENG. - - - - - - - - - 3 Regent St. S.W.

ADVERTISEMENTS

Orders for advertising should reach the office of publication not later than the 5th and 20th of the month. Changes in advertisements will be made whenever desired, without cost to the advertiser.

SUBSCRIBERS

The "Electrical News" will be mailed to subscribers in Canada and Great Britain, post free, for $2.00 per annum. United States and foreign, $2.50. Remit by currency, registered letter, or postal order payable to Hugh C. MacLean, Limited.

Subscribers are requested to promptly notify the publishers of failure or delay in delivery of paper.

Vol. 23 Toronto, January 1, 1914 No. 1

A Municipal Electrical Association

At the recent annual meeting of the Ontario Municipal Electrical Association the advisability of broadening the scope of the association was discussed. Up to the present time the object of this association has been the discussion of matters of policy rather than of technical practice and the name electrical has been applicable only because it is an organization including municipalities who are distributing electric energy. The need of an association in which the engineers and operating men in the employment of municipalities could meet together and discuss matters of a technical engineering nature has long been keenly felt and at the recent convention the sentiment was unanimously in favor of establishing the present association on a much broader basis.

It may not be out of place to outline briefly here the situation in Canada with regard to electrical associations as existing in the past. The Canadian Electrical Association was the only association of its kind for many years and was formed for the purpose of discussing matters of common interest to private electric companies, both engineering and commercial problems being considered. A few years ago the National Electric Light Association of the United States began branching out into Canada and a number of local sections were formed, as for example in Hamilton, Toronto, Ottawa, Vancouver, etc., composed chiefly of the staff of the private company operating in any particular city, but connected in no way with the Canadian Electrical Association. Some two years ago, at the annual meeting of this latter association, it was decided to affiliate with the N. E. L. A. and the local branches, scattered throughout Canada, consented to come into the C. E. A. and be known as local branches of the C. E. A. instead of local branches of the N. E. L. A. This arrangement is still in existence.

With the growth of municipal ownership of electric public utilities in Canada the need of an association where municipal officers and engineers can meet to discuss electrical matters has been fully recognized. Attempts have been made on more than one occasion to induce the C. E. A. to open its doors to municipal men, but without success. At the last annual convention of the C. E. A., held in Toronto last June, there was a strong and very evident feeling not only on the part of municipal men who were in attendance but the opinion was also expressed by delegates from private companies that municipalities should be included in the association. The opposition to this move, however, was sufficiently strong to prevent any change being made and the municipal men reluctantly concluded that there was no chance of the matter being reconsidered.

The inevitable result is seen in the resolution carried unanimously at the recent municipal convention appointing a committee to draft a constitution along lines somewhat similar to the C. E. A. so that matters of a technical nature may be discussed with profit to the operating engineers in the employment of the different Ontario municipalities. This association for the present is to be known as an Ontario association, but we have no doubt that ultimately its scope will be extended to include the whole Dominion, as the need for such an association is almost as great in the other parts of Canada as in Ontario. This is particularly true of the western provinces where municipal plants far outweigh in numbers the plants controlled by private enterprise.

It is plain to us that this association is the natural and only possible result of the conditions existing in Canada at the present time. The municipalities were evidently greatly disappointed at the continued refusal of the C. E. A. to allow them to enter its ranks. The problems of common interest in the electrical field are so numerous, as compared with the points at issue between the private companies and the municipal plants, as to entirely outweigh any objections to a common association, and we believe the C. E. A. has made a diplomatic error in persisting to hold the municipalities at arm's length. Speaking prophetically, we are convinced that the ultimate outcome of the present condition will be the amalgamation of all existent associations into one powerful Dominion organization with sections for technical, commercial, etc., discussions, and provincial branches for the transaction of business of a more local nature. It is inconceivable that two associations each having as its object the advancement of the electrical trade in Canada should exist side by side in an antagonistic attitude. It is quite possible that this latest municipal move is the first step in the right direction and that it will have a far-reaching influence in coordinating the opposing interests into one powerful, harmonious, national organization. Such an association would be the means of bringing the opposing sides together on common and friendly ground, where it would soon be discovered that neither is as bad as the other paints him, where actual differences of opinion would have a chance to undergo readjustment and where the general tendency would be towards a better and more cooperative feeling for the good of the electrical industry at large.

Getting the Figures Down

In spite of the fact that a large amount of construction work is imminent in the Ontario hydro-electric system, including stringing a second transmission line from Dundas to London to St. Thomas and the probability of an extra tower line connecting Niagara Falls with Dundas, the Ontario Hydro-electric Power Commission have been able to reduce the power rates to a number of cities. Recommendations have also been sent out to a number of municipalities reducing the price of power and light to the consumer. Though these recommendations are in the form of suggestions, it is of course understood that the commission have the power to enforce any rates they may set. However, each municipality is by this means given the chance to express its own point of view and if it can convince the commission that present rates are low enough and that either as a result of necessary extensions or for other causes these rates should not be reduced, the commission will not enforce its recommendation.

The following reductions have been made by the commission as mentioned above, to twelve of the municipalities interested:—

	Old price per h.p.	New price per h.p.
Hamilton	$16.00	$15.00
Dundas	16.00	15.00
Caledonia	29.10	24.00
London	24.00	23.00
Guelph	22.00	21.00
Preston	21.50	21.00
Galt	22.00	21.50
Waterloo	23.50	22.50
Berlin	22.50	21.50
Baden	37.00	32.00
St. Thomas	29.00	28.00
Port Credit	31.00	28.00

The conditions in Ottawa also favor a considerable reduction in the price to the consumer as the commission have been able to close a contract with the Ottawa & Hull Electric Company for the supply of 20,000 h.p. for a period of 35 years at a somewhat reduced rate. Up to the present time the commission has been paying this company $15 per h.p. but the following scale will be enforced after the beginning of the year:—Up to 5,000 h.p., $14; 5,000 to 8,000, $13.50; 8,000 to 10,000, $13; 10,000 to 12,000, $12.50; 12,000 to 14,000, $12; 14,000 to 16,000, $11.50; 16,000 to 18,000, $11. This power is purchased on a twenty minute peak load monthly basis and the commission is required to take up to 75 per cent. of the power held in reserve under the contract. This is an arrangement entirely similar to that existing with the Ontario Power Company, of Niagara Falls.

Electrical Inspection Appointments

The city of London is the most recent addition to the ranks of those municipalities which believe in having their electric installations properly inspected. A very capable officer in the person of Mr. W. B. Legate has just been appointed inspector and by all accounts he is going to be backed enthusiastically by the private and municipal systems and by the electrical contractors. The spirit of co-operation was very evident on the occasion of a recent address by Mr. H. F. Strickland, chief electrical inspector of the Hydro-electric Commission of Ontario, who explained at length the system of inspection the commission have decided to inaugurate and the advantages to be gained by it. Under the London by-law it is now necessary to get a permit to install electric wiring just as, in the past, a building permit has been required, and the officers of the law have authority to stop any work being carried on without such permit. Approval of the installation work is further necessary before the building will be connected up to any source of supply. There is no doubt that these requirements will both tend to ensure against electric work being installed either according to unsafe specifications or by incompetent contractors. Poor work in the past may be attributed either to incompetence or dishonesty. The former can now be eliminated by the refusal of a permit; the latter will be held in check by the fact of the final inspection.

It is gratifying to note the ready response of the various municipalities to the Commission's attempts to remove the dangerous conditions existing at many points in Ontario. It is not clear, however, that those municipalities which are most in need of the medicine are the most eager to accept it. Up to the present time inspectors have been appointed in London, Ottawa, Berlin, Waterloo, Tillsonburg, Stratford, Port Arthur, Fort William, Welland, Goderich and Clinton., and by-laws have been passed similar to that of the city of London, but it is noticeable that one or two of the larger cities, where conditions are far from satisfactory, are very tardy in taking action. This is perhaps largely due to competitive conditions existent in those cities, but since more stringent regulations would affect all about equally this excuse alone would not appear to carry sufficient weight to cause further delay. The only other evident excuse is that the cost of some of the installations might possibly be greater, under independent inspection, than at present, on account of more stringent requirements. The placing of safety to life and property against a little added expenditure is surely bad business, however, and ought to be, in this electrical age, a practice only of the past.

Good Advertising

Much can be done by the central station owner or manager to advertise his electric wares and it is just possible that the average central station man does not appreciate fully that his customers have very little information regarding electric household appliances and the value of their more general use. A good deal has been written and said about the maintainance of demonstration rooms and a number of companies and municipalities are taking this matter up actively and, we understand, with very excellent results. Among this number is the Trenton Electric & Water Company of Trenton, Ont., who recently opened an electric shop where they give demonstrations on electric cooking and heating devices. We reproduce herewith the invitation card which was widely distributed by the Trenton Company and is so nicely worded and so artistically printed that we should imagine anyone receiving an invitation would feel almost as if he had received a complimentary to a conversazione. It follows that there are very few who would decline to accept the invitation and the useful and educative results from the point of view both of the customer and the central station can be readily imagined.

The Trenton Electric and Water Co., Limited

invite you to attend a

Demonstration of Electric Cooking and Heating Devices

at

"The Electric Shop"

Dundas Street, Trenton

Tuesday, December Sixteenth

from two to nine p.m.

The showing of goods electrical will be unusually interesting, including
many new appliances that add greatly to the comfort
of a modern home or office

A. T. Hicks, Manager

The city of Winnipeg light and power department are building a 12,000 volt transmission line between their sub-station and the G. T. P. shops in Transcona. The town's interest in this matter, as well as others of an electrical nature, are taken care of by W. E. Skinner, Limited, their consulting engineers.

A Letter Regarding Electrocution

Winnipeg, Manitoba.

The Editor, Electrical News:

Hardly a week goes by but there is mention in the Daily Papers of the electrocution of some member of the electrical fraternity. Accidents are bound to occur, as no apparatus invented so far is absolutely fool proof; also to err is human, and no matter how careful one may be, there are times when familiarity breeds contempt, and the presence of continual danger is lost sight of. In looking at all branches of applied science, electrical engineering stands alone in the way of having least protection afforded for its workers. By-laws have been framed for the protection of buildings, apparatus, etc., but very little seems to have been done for the protection of those installing and handling electrical apparatus, and it is refreshing to note that various organizations throughout the country are taking up this side of the question with a view to preventing loss of life.

Certain statistics are available showing the actual loss of life by electrical workers throughout the country, as far as is known, but the following figures do not, of course, cover cases that are not on record, having occurred outside such precincts of jurisdiction where statistics are not easily obtainable.

From June, 1910, to May,1911, inclusive, there were 31 electrocutions, resulting fatally, throughout the Dominion.

From April, 1912, to April, 1913, inclusive, the Electrical Workers' Union had 66 members fatally shocked. This figure does not include electrocutions outside of the Union, and therefore, does little more than show the immense increase in the death list since 1910.

In October, 1913, five electrocutions with fatal results occurred, and the same number in November, 1913.

If protection were brought to the highest state of perfection a good many accidents would still result owing to actual carelessness on the part of individuals involved, as it is unfortunately the case that 90 per cent. of accidents in connection with the above subject are due to carelessness on the part of individuals, and just how far such individuals would be further protected by adequate protection in the way of legislation and by-laws, etc., is rather an unknown quantity.

Coming to the matter of the various methods of resuscitation, we must consider certain phases of the question that do not actually cover the word resuscitation itself, but rather more in the need of organization of centralized committees to skilfully and promptly apply the most advanced methods known to the medical and electrical profession. Of all cases of electrocution that have come to the writer's notice in the last few years, the majority of them appear to be of such a nature that, had proper methods of resuscitation been applied, the unfortunate victims would have been brought back to life. Also, it is a lamentable fact that a good many worthy gentlemen of the medical profession are so far not very well acquainted, owing to lack of experience, with just how far methods of resusciation should be prolonged before giving up all hope of bringing the victim back to life. There is no question in the writer's mind that 90 per cent. of the cases of shock, even though the victim may appear dead by all known tests of materia-medica, should not be given up for at least three or four hours, so as to give the victim every possible chance. The writer's experience of these matters, and reference to statistics, have prompted him to write this letter, which is being sent to the Press and also to the heads of the various universities. In the former case, it will give publicity to a vital subject, resulting in a more general knowledge of the matter in hand, and in the second case, the writer hopes that the principals of the various universities may see their way clear to embody in their curriculum of electrical engineering a thorough knowledge of the various methods of resuscitation from electric shock, as there is no question but that at least 50 per cent. of the present mortality due to electric shock could be avoided were every electrical worker thoroughly familiar with what to do in the case of a fellow worker being shocked.

As a suggestion of the best method of taking care of such cases mentioned above, the writer feels that it would involve no great hardship for all cities to form some central committee composed of good first aid men of the electrical profession and medical profession, at least some of which committee could always be gotten at from some central point by telephone or other means, in case of an accident occuring, so that if any worker were at any time badly shocked some center such as the central police station, the fire hall, the general hospital or power house, could be notified, and from there orders issued for two or three available members of the committee to immediately repair to the scene of the accident.

This letter is written in the hope that there will be a greater interest taken in this subject, and if publicity to same helps in any way to reduce the enormous loss of life apparent in this field of engineering, the writer's object will have been attained.

Charles F. Gray,
Mem. A.I.E.E.,
Assoc. Mem. I.E.E.

Striking Examples of Resuscitation

Dr. Chas. A. Lauffer, medical director of the Relief Department of the Westinghouse Electric & Manufacturing Company recently made some interesting statements regarding the resuscitation of victims of electric shock. Dr. Lauffer states that cases are on record where shocks received from 8,000 and 10,000 volt lines have not proved fatal and where patients have been declared dead by physicians and yet have been resuscitated by the prone pressure method of resuscitation. He says that because the prone pressure has no apparatus to sell it gets very little advertising and the general public has too little information of its value. The following extracts from a paper recently prepared by Dr. Lauffer are full of useful information.

"Men have received 8,000 and 10,000 volts—we personally know of one who received 11,000 volts—and recovered. Arc and static discharges from 240,000 volt conductors, and even higher voltages, are not necessarily fatal, if artificial respiration is resorted to at once, as the following actual instances will show:—

Case A—During July, 1913, a patient received 8,000 volts. He was unable to release himself from a live wire he had inadvertantly touched, and which was fastened to a switchboard. He had failed to trace its source, but started to unscrew the connection; his right hand touched the screw, his left hand held the bare wire, while the current went through his body. The left hand folded over the right breast, and in falling his right forearm and back came in contact with iron piping. He was badly burned in five places.

The comrade nearest him who saw him drop, took four steps to pick up a piece of wood, ran back the four steps and knocked the line out of his hand. The duration of the dangerous contact exceeded fifteen seconds.

It required fifteen minutes of rhythmic effort at artificial respiration to get him back to normal breathing. For a time he breathed as though every breath would be his last, his diaphragm being in tetanic contraction, but by increasing the elevation of the diaphragm at the rate of twelve times a minute, by the prone pressure method, this spasmodic type of respiration subsided, and normal breathing was restored. Mr. E. V. Saunders rescued him from the line, and he, together with Mr. C. W. Diehl have the honor of this resuscitation.

Case B—This accident occurred five years ago. The patient opened a live circuit and fell against a steel hose, receiving 10,000 volts, and the contact was of several seconds duration. He lost two fingers and carries ugly scars on his palm, wrist and back. His case presented a severe complication, edema of the lungs; fully two pints of bloodstained serum was expectorated, but he reacted to drugs and cracked ice, and his burns healed happily.

The honor of this rescue and resuscitation belongs to Mr. F. S. Peterkin, a man who has resuscitated six men without a failure. One hundred per cent of success is noble achievement; all of his cases were at high voltage, and of a serious type. Why this man's uninterrupted success? He gets busy at once, for every second is an hour when the action of a man's diaphragm is paralyzed. He works continuously at the artificial respiration; he does not stop to theorize about the fibrillating heart, or the probability of hemorrhage in the brain and spinal cord. A victim of electric shock, and other conditions requiring resuscitation, needs instant assistance in the way of artificial respiration; few persons are killed outright by electricity.

Case C—This man received 11,000 volts, yet was successfully resuscitated. His palms were so deeply burned that both hands were subsequently amputated.

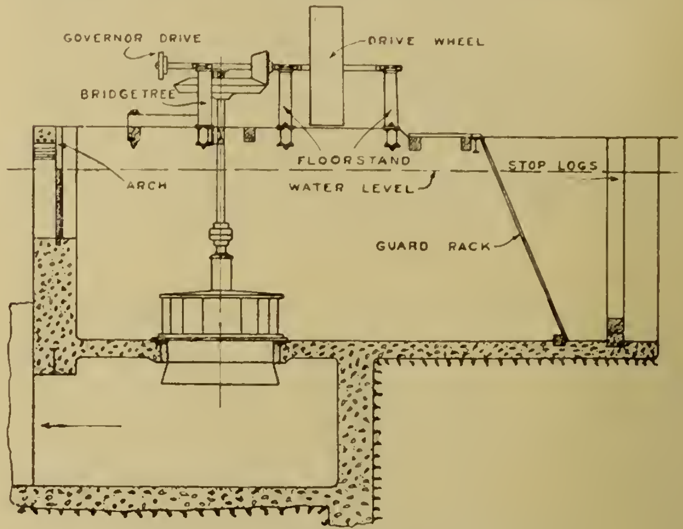
Cases are on record, moreover, where patients were declared dead by physicians, yet by the prone pressure method of artificial respiration have been resuscitated. But because prone pressure has no apparatus to sell, it has no publicity department and the general public is too little informed of these successes. There will always be need of manual methods, yet some of the mechanical devices should probably be endorsed. But until all cases are honestly reported, manual methods will not receive due publicity; the commercial interests back of the mechanical devices boost their apparatus, and disparage manual methods, notwithstanding the fact that manual methods are necessary to keep the patient alive until the apparatus can be brought to the scene. It is then customary to give such apparatus the entire credit for the resuscitation.

Small Private Plant in Inglewood

A neat hydro-electric plant was recently placed in operation by the Shale Products Company, Limited, of Inglewood, and we publish herewith a few of the more important details. The plant is situated on the Credit River, about three-quarters of a mile from the town and was planned by Chas. Barber & Sons, Meaford, who also supplied and installed all the hydraulic equipment. The turbine is a 70-inch, normal speed, vertical type wheel and power is transmitted through machine dressed, bevel gears to a jack shaft carried on substantial iron bridge-trees on which shaft a large drive wheel is installed. From this wheel the power is transmitted by belt to the generator. The exciter is belt-driven off the generator shaft.

All the hydraulic construction work is of concrete, with steel reinforcement, and is designed for a working head of 12 feet under which condition the turbine develops a capacity of 185 h.p. The turbine is controlled by a size D Woodward compensating governor and the regulation is claimed to be such that a minimum of attention is required in operating the plant. The generator was installed by the Canadian Westinghouse Company, and supplies current direct to the transmission line at 2300 volts. The transmission line to the factory is No. 6 bare, hard-drawn copper wire.

View of interior—Shale Products Co's plant.



Section through Shale Products Co.'s plant.

The electrical installation at the consuming end consists of three 30-kw. transformers, one small lighting transformer, two large and three small motors. The three large transformers step the current down to 550 volts for driving small motors which are used to operate conveyors, a pump and a fan. The machinery driven by the two large motors is divided into two groups; the first group includes three dry pans and three 30-foot elevators; the second group includes a brick machine, two pug mills, a cutter table, tailings conveyor and clay feeder. Both the large motors operate at 2200 volts directly off the transmission line, the first having a capacity of 125 h.p. and the second a capacity of 150 h.p.

This company was organized in 1912 for the manufacture of high grade vitrified brick out of the Medina shales. The officers are Messrs. T. H. Graham, president, J. M. Scott and J. R. Scott, all of Inglewood.

First Meeting Toronto Section A. I. E. E.

The first regular meeting of the Toronto section of the A. I. E. E. was held in the engineers' club, 96 King St. West, on Friday evening, December 9. Mr. J. A. MacMurchy, of the Westinghouse Machine Company, Pittsburgh, Pa., gave an illustrated talk on steam turbines. An interesting feature of the lecture was a description of a 30,000 kw. unit recently manufactured by the Westinghouse Company and which has been shown to have an economy of about 12 pounds of steam per h.p. hour.

It is understood that the Board of Commissioners appointed to control the electrification of the London & Port Stanley Railway will be in a position to place orders for the necessary equipment in the near future, Mr. S. B. Storer will be engineer in charge of the work.

Pine River Plant Extensions

The Pine River Light & Power Company have recently added largely to their hydro-electric plant situated on the Pine River, a tributary of the Nottawasaga, some 22 miles from Orangeville, at which point the head office of the company is located. The Pine River Light & Power Company was incorporated to take over the business of the Dufferin Light & Power Company which had in turn taken over the lighting and power plants of Orangeville and Shelburne. The company now serve Orangeville, Shelburne and Horning's Mills and is making preparations to serve Dundalk and possibly Grand Valley and Arthur, the latter of which would require a 28-mile distribution line. The company maintain a steam auxiliary plant in Orangeville.

During the past summer a new dam has been completed which is 675 ft. in length, 60 ft. high, 300 ft. in width at the bottom and 25 ft. at the top. The dam is built of clay with a puddled clay core. The face of the dam is rip-rapped with stone and is strengthened by a retaining wall of stone 20 ft. high, 10 ft. wide at the base and 7 ft. at the top. The dam is sloped 2½ to 1 on one side and 2 to 1 on the other side. The lake formed has an area of 75 to 80 acres. A cement fore-bay fitted with iron racks leads the water into a wooden flume 1,600 ft. in length. This pipe is circular, 42 inches in diameter the staves being held together by iron bands placed 7 to 10 inches apart. The lower 350 ft. of the flume is of steel pipe. A stand pipe 26 ft. in height has been installed at the junction of the wooden and steel pipes to take care of water surges. The total fall obtainable is 139 ft. The power house is constructed of cement and measures 36 x 48. The turbine chamber is separate and divided into three sections, in two of which 300 h.p. units have been installed. The third unit will be put in as required, so that the plant will ultimately be capable of generating 900 h.p.

New Pine River dam, forming 80 acre lake.

Power House and pipe line—Standpipe in the distance.

Interior showing one of the generators, etc.

The turbines are the Jenckes snail steel type and each is direct-connected to a 175 kv.a. Westinghouse 2200 volt generator with belted exciter. Current is stepped up to 22,000 volts for transmission.

The president of the company is Mr. J. M. Kilbourn, Owen Sound; Mr. T. R. Huxtable is secretary and manager.

Western Canada Power Development Plans

Mr. R. F. Hayward, general manager of the Western Canada Power Company recently read a paper before the Vancouver Branch of the Canadian Society of Civil Engineers on the hydro-electric development of the Western Canada Power Company, Limited, at Stave Falls, B.C. A synopsis of Mr. Hayward's remarks follow:—

The paper, which was illustrated by a number of lantern slides, described the design and construction of the power plant which is now in operation at Stave Falls, gave a general outline of the proposed additional developments on the Stave River, which will ultimately bring the capacity of the plants to 120,000 horse power, and dealt very fully with the question of water supply and the most economical development that could be made under the physical conditions which obtain in the Stave Valley.

The existing plant is designed for four 13,000 h.p. units, two of which are now in operation, with two additional ones on order. The development consists of a heavy concrete intake dam about 60 feet high, which is to be raised in the course of the coming year another 20 feet; a sluice dam consisting of piers closed by removable stop logs; a reinforced concrete power house on a foundation excavated out of solid rock, and a tailrace about 1,500 feet long excavated to a depth of about 30 feet. The power house is now operating under 100 ft. head and, when the dam is completed to its full height, will operate under a maximum head of 120 feet.

From the tailrace of the existing plant to the mouth of the Stave River there is available for further development, a fall of 130 feet. Two plans of developing this fall are now under investigation; the first contemplates the whole development at one place and involves the construction of a dam 165 feet high in a rock gorge at the mouth of the river. The second plan provides for two power houses each operating under 65-ft. head, one to be built at the mouth of the river, the other about one mile below the existing plant at Stave Falls. On account of the great saving that can be made in the cost of dams, the two low head plants will probably prove the most economical development.

Stave Lake lies to the north of the Fraser River about 35 miles east of Vancouver. The watershed, which is only partly explored, has an area of about 450 square miles. It is formed by the granite mountains of the Coast Range, which rise to elevations of over 8,000 feet, and carry perpetual snow. The river, from its source in a large glacier, to the mouth of the Fraser River, is about sixty miles. The lake has an area of about 12 square miles, and lies at an altitude of 230 feet above sea level. Three is a fall of only 14 feet in seven miles of the river from the foot of the lake to Stave Falls. There it drops about 80 feet and flows thence in a series of rapids to its tidal mouth at Ruskin on the Fraser River.

The annual rainfall, taken over a period of the last twenty years in the vicinity of Stave Falls, has averaged 77.5 inches with a minimum year of 50 inches, and a maximum year of 90 inches. The average precipitation over the drainage area is unknown, as Stave Falls is the only point at which a rain gauge has been established. Stream measurements have been taken continuously for nearly six years. The mean annual run-off of the river is approximately 4,000 cu. ft. per second, and the lowest mean annual run-off was 3,400 cu. ft. per second. The ratio of run-off to the precipitation as measured at Stave Falls is 1.6, which indicates that the average precipitation over the whole basin is probably twice the precipitation at Stave Falls.

The maximum flood discharge that has been measured in the natural state of the river is about 36,000 second feet, but if the controlling action of the lake were eliminated the actual maximum flood run-off would be nearly 60,000 c.f.s. and this is the amount which must be taken into account in calculating the design of spillways.

It is practicable to build a dam at Stave Falls to raise the water 40 feet above its low level, thus increasing the area of the lake for storage purposes from 12 to 24 square miles.

Mass curves of the run-off having been plotted for the past six years and the following series of curves has been computed to determine the most economical development that could be carried out, viz:

1. A curve showing mean flow available for varying height of dam.
2. A curve showing mean head available for varying height of dam.
3. A curve showing mean power available for varying height of dam.
4. A curve showing mean cost of increasing height of dams to store water 30, 35 and 40 feet above low lake level.

From these curves the maximum available power on a sixty per cent. load-factor with turbine efficiency of 83 per cent. is worked out as follows:

	h.p.
1. For dam to store water 30 feet above low level	52,000
2. For dam to store water 35 feet above low level	59,000
3. For dam to store water 40 feet above low level	64,000

The cost of increasing the dams above the 30 foot level worked out as follows:

From 30 to 35 ft. level	$20.00 per h.p.
From 35 to 40 ft. level	25.00 per h.p.

Beyond this limit the cost per h.p. increases very rapidly.

The power house was designed to operate under a maximum head of 120 feet, a minimum of 100 and a mean of about 110. It was laid out for four 13,000 h.p. units.

The turbines, which are horizontal type, double Francis wheels with central discharge, running at 225 revolutions, were built by Escher Wyss & Company, of Zurich, and the 9,000 kv.a. generators were built by the Canadian General Electric Company.

The intake dam is founded upon solid rock and is built of concrete, heavily reinforced at certain parts. There are four main intake gates of the radial type, each gate closing an opening 20 feet square under a maximum head of 45 feet.

Each penstock is 14 ft. 6 ins. in diameter, and about 150 feet long. The power house foundation is excavated out of solid rock, and the building is a heavily reinforced concrete structure.

Port Arthur's Fine Prospects

Mr. J. J. Hackney, Port Arthur Utilities Commissioner, presented a very interesting report at a recent meeting of the Board of Trade, in which he outlined the power situation in the city of Port Arthur. All public utilities in this city are municipally controlled, the power supplied being partly obtained from the Hydro-electric Power Commission of Ontario, who buy from the Kaministiquia Power Company, and partly from their own plant on Current River. Mr. Hackney's remarks in part follow:—

" The apparatus contained in our Current River plant consists of 1,560 h.p., A.c., and 270 h.p. d.c. equipment. With this equipment we are able to develop for five or six hours, 1,600 h.p., and in addition, a continuous load of from 500 to 700 h.p., or a combined load for a short time of 2200 h.p.

The municipal plant is tied in to the Hydro-electric Power Commission's sub-station, which is at present being enlarged to a capacity of approximately 10,000 h.p. Our present peak from this station is 2,100 h.p. The city's power load is at present approximately 7,000 h.p., as follows:

	h.p.
Electric light	1890
Street railway	1600
Government elevator	900
Dry dock	830
Water works	450
C. N. R. elevator	400
Street light	200
Stewart & Hewitson	250
With a number of smaller consumers	480
Total horse power	7000

This year, on the advice of the Hydro-electric Power Commission, we combined the power and electric light departments under the head "Electric Department." The gross revenue from this department for the year will be approximately $165,700, or a net revenue over and above all maintenance, interest and sinking fund charges, of $62,000. When we compare this with the past five years, it will give you as good an indication of the growth of the city, as the assessment. The comparison is as follows:

1909 net profit	$5,242.00
1910 net profit	11,301.00
1911 net profit	11,968.00
1912 net profit	42,688.00
1913 net profit	62,000.00

Bear in mind that the metered light rates have been lowered twice during the past two years, until now we have the lowest rate in existence in the Hydro belt, and good chances of a further reduction in the near future. We have at present 3,325 light consumers and 55 power consumers, 500 light services were installed this year, and 10 power consumers added. The total capital investment of the city in the Electric Department is $570,000.

Our contract with the Hydro Commission provides for 5,000 h.p., of which we are taking 2,100 h.p. This amount we are hoping to increase to 4,000 or 4,500 next year. Among some of the consumers we hope to get are the C. N. R. Coal Dock and the Davidson-Smith elevator and mill, and an increase in the water works of 600 h.p. When we increase the amount taken from the Hydro to 4,000 h.p. we get a reduction of $1.00 per h.p.

Forseeing the rapid development in this department, early in the year, I recommended to the Council the advisability of requesting the Hydro-electric Commission to make a report on the development of Dog Lake. This was done, and surveyors have been working for several weeks on this development. With Dog Lake developed, we should be able to get high tension power delivered to the city at $9.00 to $10.00 as against $16.00 at the present. We should then be able to deliver to consumers, low tension power at about $15.00 to $16.00 per h.p., with a corresponding decrease in light to, say, two cents per kw.h.

Another matter in this department that is rapidly coming into use, is electrical cooking. We have supplied a number of electric ranges to citizens, that have given good satisfaction. This range can be supplied at $75.00, and will give satisfactory service to a family of five or six, for a monthly payment of $3.50. If this department is developed it will give a large revenue to the electrical department, also a very cheap fuel to consumers.

Early in the season we commenced the sale of tungsten lamps, and we have been able to give a guaranteed lamp to the consumers for 40 cents for 25 watt and 40 watt lamps, and 45 cents for 60 watts. We have sold during 1913, 11,000 lamps.

Telephone Department

While I am on the subject of utilities, I may be pardoned if I mention the Telephone Department, which is also doing very well. We have at present 2,700 subscribers, an increase of 400 during the year. The gross revenue of this department for this year will be approximately $46,000, and will show a nice net profit, even with the lowest telephone rates in the Dominion.

Street Lighting

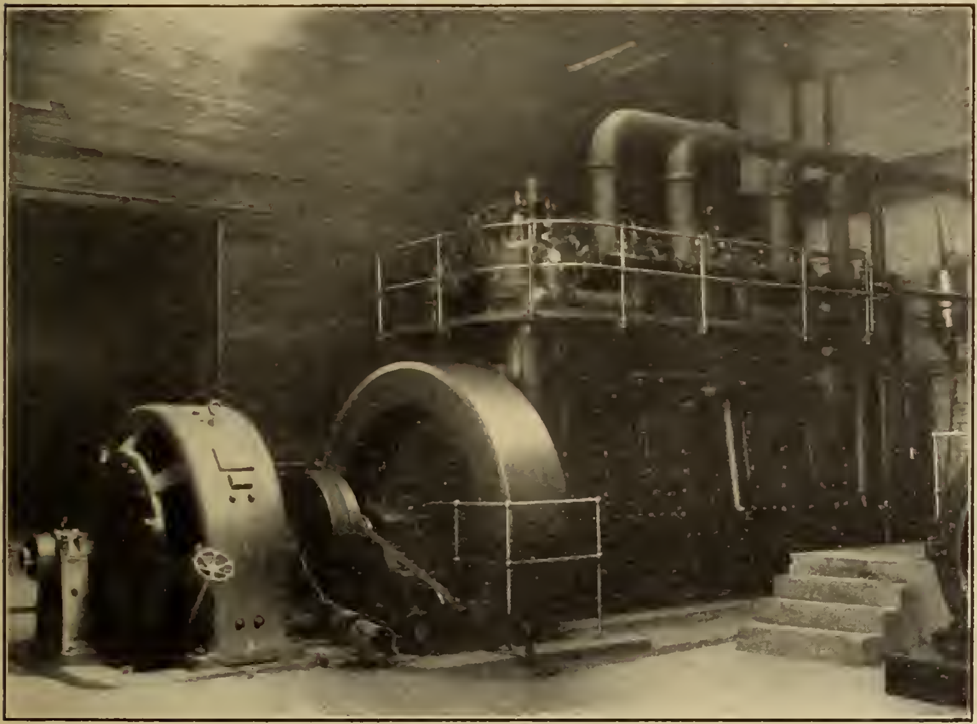
I might mention the street lighting department, also. We have installed 2,200 lights during the last two years, making this city second to none for well lighted streets, and here again, we stand out with the cheapest rate, with one exception, in the Dominion as far as I am aware.

The gross revenue from all our Utilities for the year will be approximately $535,000."

Port Arthur's domestic lighting rate is 4c per 100 sq. ft. plus 3c per kw.h., less 10 per cent.; commercial lighting, 8c per kw.h. for first hour's daily use of installed capacity for 26 days per month and 3c for all excess, less 10 per cent.; power rates, $25.00 per h.p. under class A unrestricted power use, class B $20.00, class C $15.00; metered power $1.30 per month per h.p. of demand for first 10 h.p. and $1.00 for all excess, plus meter charge of 2½c per kw.h. for first 50 hours of maximum demand, 1¾c for second 50 hours and 1c per kw.h. for all excess.

Largest Diesel Unit in Canada

The Moose Jaw Electric Railway Company have recently added a 500 h.p. Mirrlees-Diesel engine and generating plant to their power station and have just placed a repeat order for an exactly similar unit. As the Moose Jaw company originally installed two units of this type, it may be taken as indicating the satisfactory operation of the Diesel engine, and indeed we understand the company are greatly pleased with their experience with this type of machine. The 500 h.p. engine, which is now in daily operation, averaging 18 hours per day, has also shown that the operating expenses are well within the guarantee given by the manufacturers.



500 h. p. Diesel unit recently installed by the Moose Jaw Electric Railway Co.

This is the largest Diesel engine at present operating in Canada. It will be seen from the photograph herewith that it is of the four-cylinder type, each cylinder developing 125 B.h.p. The engine is fitted with Mirrlees valve and other patented improvements.

The simplicity and ease with which this large unit is handled is said to be simply wonderful and this, coupled with the fact that it can be started up from cold and put on the load in less than one minute, makes it an ideal prime mover for traction purposes, more especially as there are no stand-by losses when the engine is not running. Another feature is the excellent regulation which takes care of the heaviest fluctuations of the load.

This engine was started up about the middle of the year, since when it has practically been in operation for 18 hours daily. The units have all been supplied by the Boving Company of Canada, who also have the order for the other 500 h.p. unit to be installed in 1914.

As indicating the possibilities for development in the business of electric supplies the Stuart-Howland Company, who specialize on line material, illumination fixtures and electric heaters state that during the last year they have added seven travelling salesmen to their sales force and that their sales have largely increased notwithstanding the somewhat unfavorable conditions that prevail in the trade throughout the territory covered, and that their business in electric heating supplies has increased more than 5000 per cent. in five years. In other words, the sales for all kinds of electric heating material for the past year were more than 50 times what they were five years ago.

Electrical Statistics

A copy of the reports, returns and statistics of the inland revenues of the Dominion of Canada for the year ending March 31, 1913, relating especially to weights and measures, gas and electricity, is just to hand and that part of the statistics which deals with electricity is of special interest to our readers.

As is usual the statement includes a table showing the number of electric meters presented for verification, verified, rejected and verified after first rejection. In a number of districts no meters were rejected at all, these being Fort William, Montreal, Sherbrooke, St. Hyacinthe, Three Rivers, and Edmonton representing a total of over 22,000 meters. The total number of meters presented for verification was 118,639 of which only 189 were finally rejected amounting to approximately one-eight of 1 per cent. The complete table is given herewith:—

Districts.	Presented for Verification.	Verified as coming within the error tolerated by law.			Rejected			Verified after first Rejection.			Totals.	
		Correct.	Fast.	Slow.	Unsound.	Fast.	Slow	Correct.	Fast.	Slow.	Verified.	Rejected.
Belleville	3,063	1,625	826	611	....	....	1	....	....	....	3,062	1
Fort William	111	38	31	42	....	....	....	....	....	....	111	....
Hamilton	7,091	4,140	1,198	1,752	....	....	1	....	....	....	7,090	1
London	5,180	1,838	1,827	1,505	1	4	5	....	....	....	5,170	10
Ottawa	6,112	754	3,650	1,691	5	2	10	....		....	6,095	17
Toronto	21,448	10,358	5,909	5,162	....	4	11	2	1	1	21,433	15
Montreal	16,130	12,592	2,260	1,278	....	....	....	....	....	....	16,130	....
Quebec	1,303	1,168	20	111	....	....	2	2	....	....	1,301	2
Sherbrooke	800	294	219	287	....	....	....	....	....	....	800	....
St. Hyacinthe	395	127	197	71	....	....	....	....	....	....	395	....
Three Rivers	245	187	28	30	....	....	....	....	....	....	245	....
St. John	2,020	761	798	448	....	7	6	....	....	....	2,007	13
Halifax	2,752	1,658	803	215	68	1	7	....	....	....	2,676	76
Charlottetown	192	79	50	60	3	....	....	....	....	....	189	3
Winnipeg	19,279	4,497	9,834	4,941	2	1	2	....	2	....	19,274	5
Regina	3,738	1,496	1,663	560	5	7	7	....	....	....	3,719	19
Calgary	6,265	1,668	3,155	1,432	....	6	1	2	....	1	6,258	7
Edmonton	4,565	1,768	2,555	242	....	....	....	....	....	....	4,565	....
Vancouver	14,414	5,425	7,212	1,757	1	12	5	1	....	1	14,396	18
Victoria	3,536	1,756	1,318	460	....	1	1	....	....	....	3,534	2
Totals	118,639	52,229	43,553	22,655	85	45	59	.7	3	3	118,450	189

The statement of revenues and expenditures shows that the total revenues amounted to $74,833.80 and the total expenditures to $42,712.88, leaving a balance of $32,120.92.

A very interesting feature of this government report is that part dealing with the export of Canada's electrical energy which is now reaching very considerable proportions. There were at date March 31, 1913, seven companies exporting electricity into the United States with three more preparing to do so. From the table appended herewith it will be seen that there is more electric energy produced in Canada for export than for home consumption. This is particularly true of the plant at Fort Frances, of the Canadian Niagara Power Company and of the Maine & New Brunswick Electric Power Company. A complete statement is given herewith showing the total amount of electric energy expressed in kw.h. and h.p. years for export and for consumption in Canada by the different hydro-electric companies operating near the border line.

An Active Committee Appointed

At the annual meeting of the Ontario Municipal Electric Association held in Toronto on December 8 it was recommended that the sum of $25,000 be set aside annually for the payment of the three members of the Hydro-electric Power Commission of Ontario. It was suggested that this be apportioned as follows:—Hon. Adam Beck, chairman, $15,000; W. K. McNanught and Hon. J. S. Hendrie $5,000 each. The following officers of the association were elected for the ensuing year:—President, J. W. Lyon, Guelph; first vice-president, E. T. Sifton, Hamilton; second vice-president, Philip Pocock, London; secretary-treasurer, E. M. Ashworth, Toronto; executive, S. Carter, Guelph; W. H. Bradburn, Peterboro; Filbert Roche, St. Thomas; W. D. Euler, Berlin; R. G. Black, Toronto. Along with other business transacted the following resolution was unanimously adopted. This item is commented on editorially elsewhere in this issue. Resolved: That a special committee be appointed to report to the Executive on the advisability of re-arranging this Association on a broader basis following that of the Canadian Electrical Association, and to consider the proposition of an annual convention and exhibition, as well as to arrange for periodical meetings of the engineering and executive heads of Municipal Electric departments, for technical, business and educational co-operation.

Engineers Sifton, Glaubitz and Couzens, and the Secretary-Treasurer, were appointed a committee.

The earnings of the Shawinigan Water and Power Company have shown a continuous increase throughout the year. In January the earnings were $131,000, and in November they had gone up to $138,000, a record for any month. The following tables shows the earnings from 1907: 1913 (eleven months) $1,480,351; 1912, $1,569,671; 1911, $1,349,715; 1910, $991,029; 1909, $819,171; 1908, $706,244; 1907, $581,192.

Name of Contractor.	Place of Business.	Units Produced for Export.		Units Produced for use in Canada.		Total Output of Generating Station or other Source.	
		Kilowatt Hours.	Horse Power Years.	Kilowatt Hours.	Horse Power Years.	Kilowatt Hours.	Horse Power Years.
Ontario & Minnesota Power Co	Fort Frances, Ont.	21,233,520	3,334·20	1,094,513	167·51	22,328,033	3,501·71
Canadian Niagara Power Co.	Niagara Falls, Ont.	325,775,842	49,850·25	10,986,988	1,682·24	336,762,830	51,532·49
Electrical Development Co.	"	55,034,200	8,421·51	155,773,208	23,837·39	210,807,408	32,258·90
Ontario Power Co..	"	254,286,580	38,912·66	284,950,978	43,503·09	539,237,558	82,515·75
* Electrical Distributing Co.	Windsor, Ont.	....	....	....	....	....	....
* Sherbrooke Ry. & Power Co	Sherbrooke, Que.	....	....	....	....	....	....
Maine & New Brunswick Electric Power Co	Aroostook Falls, N.B.	2,371,446	362·89	63,070	9·65	2,434,516	372·54
British Columbia Electric Ry. Co	Vancouver, B.C.	282,383	43·21	120,789,188	18,477·83	121,071,571	18,519 14
Western Canada Power Co..	"	3,259,693	498·80	18,191,562	2,784·87	21,461,255	3,285 67
* Cedars Rapids Power Co.	Soulanges, Que.	....	....	....	....	....	....
Totals	....	662,243,664	101,423·52	591,849,507	90,462·58	1,254,103,171	191,986·20

* These companies have not yet commenced to export.

Total amount of electric energy generated by border companies.

Electricity in the Manufacture of Lumber

Description of the Application of Electricity in the Largest Lumber Factory in Canada—The Canadian Western Lumber Company's Plant

About three miles above the city of New Westminster on the bank of the mighty stream whose name it bears, the town of Fraser Mills, occupying an area of about 640 acres, makes a powerful bid for distinction as the site of the world's greatest sawmill industry, and a place where community building and development is being successfully worked out under the aegis of a great corporation. As the result of the recent addition of a modern sash and door factory, cedar mill, shingle mill, veneer factory and box factory, the Canadian Western Lumber Company now conducts what is beyond all question the largest lumber manufacturing plant on the globe, the overall capacity being 1,000,000 feet per day of 20 hours, made up as follows:

Main sawmill, 700,000 feet; cedar mill, 200,000 feet; shingle mill, 800,000 shingles; door factory, 2,000 doors; veneer factory, 30,000 feet of built 3-ply panels; lath, 100,000 pieces; box factory (in course of construction), 25,000 feet manufactured boxes in knockdown form.

Woods handled—fir, cedar, hemlock and spruce.

Stock of upwards of 60,000,000 feet of lumber is kept constantly on hand in yards and sheds.

Storage shed capacity for 13,000,000 feet of finished lumber.

Shed capacity for rough and clear kiln-dried lumber, 800.000 to 1,000,000 feet.

Number of employees in plant when running to full capacity, 1000 (exclusive of office staff).

The timber limits owned by the company contain approximately 4,000,000,000 feet. At Comox, Vancouver Island, the firm's logging operations are on a scale unequalled on the American continent, about 750,000 feet of logs per day being handled. Even at this rate of cutting there is a sufficient supply of timber for 45 years.

Power Plant

The power producing department of this manufacturing establishment, with its net capacity of over 6,000 h.p., is considered one of its most interesting features. No expense has been spared to make this part of the plant reliable and convenient in operation. Both the boiler house and machine room are of brick, fireproof construction, and the latter is notably large, excellently lighted and well ventilated.

The boilers, sixteen in number, each 72 in. in diameter by 18 ft. long, are of the H.R.T. type built for 166 lb. B.C. inspection, and are equipped with Dutch oven furnaces. They are grouped in four batteries of four each.

Mill refuse, which is used exclusively for fuel, is carried from the main sawmill by chain conveyors, and from the planing mill by forced draught through cyclones, to the fuel shed at the end of the boiler house. The fuel from there is fed as required by conveyors to chutes, and thence by gravity to the furnaces. This boiler plant, besides supplying all steam necessary for the turbines and engines, also furnishes the required steam for sixteen double track dry kilns.

There are two steel plate stacks, 96-in. in diameter and 40 ft. high, which are used in connection with an induced draught firing system.

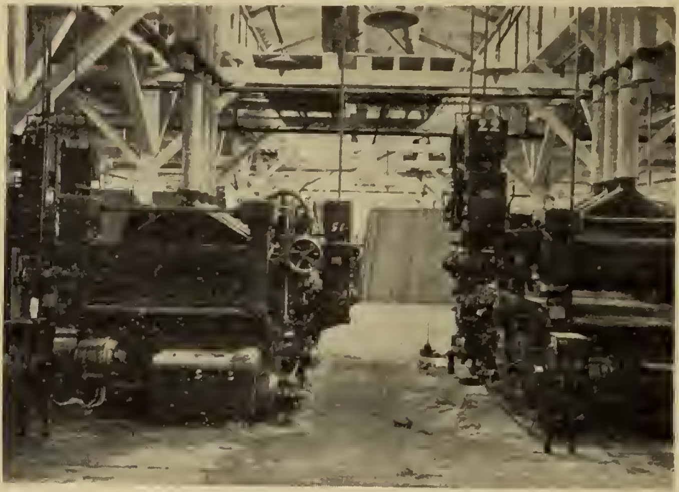
While every effort has been made to profitably utilize the by-products there is a large amount of waste material that must be destroyed, and for its disposal the company have erected two burners. The largest of these, supplied by the Muskegon Boiler Works, Muskegon, Mich., and said to be the largest burner of its kind in the world, is used for the disposal of offal from the main sawmill and planing mill. This burner is 54 ft. outside diameter, 50 ft. inside diameter, and has a 2-ft. radial water space. The total height of the burner is 161 ft. with a water jacket 86-ft. high. Circulating water is supplied by a 1300 U. S. gallon motor driven turbine pump. A smaller brick lined burner 42 ft. in diameter and 125 ft. high is installed near the cedar mill, and handles the refuse from this part of the plant, as well as from the shingle mill and sash and door factory.

In the machine room are one 18 in. by 42 in. Allis-Chalmers, twin, Corliss engine operating a 93 r.p.m.; another of the same type and make 22 in. by 42 in. operating at the same speed, and a 30 in. by 36 in. slide valve engine manufactured by the Hamilton Manufacturing Company, operating at 135 r.p.m. These engines are driving, by belts, practically all the machinery in the main sawmill.

The first electric power generating equipment installed by the company was an Allis-Chalmers 750 kw., 1800 r.p.m. 480 volt, three-phase, high pressure steam turbo-generator. A 10 in. by 18 in. by 18 in. C. H. Wheeler combined single air pump and jet condenser was furnished with this turbine unit.

1500 kw. mixed pressure unit recently installed

When it was decided to enlarge the manufacturing facilities, and to adopt motor drive for all additional equipment, increased generating capacity was required. The three large engines already mentioned were operating non-condensing, and, therefore, deriving only a portion of the available energy from the steam they consumed. It was decided to purchase a turbine so designed that advantage could be taken of this lost energy, and it was also stipulated that the machine should be capable of operating economically on high pressure steam. The machine chosen has a capacity of 1500 kw. at 80 per cent. power factor, operating at 1800 r.p.m., and is of the mixed pressure Curtis type. It is designed to operate on high pressure steam at 130 lb. and low pressure steam at 16 lb. absolute, with a vacuum of 28 in., and is capable of carrying its rated load with steam at either pressure, or at both pressures in proper proportions. It is noteworthy that this machine uses high pressure steam in the same economical manner as Curtis turbines designed for high pressure operation only. Steam is admitted to the turbine from the low pressure inlet pipe by a butterfly throttling valve, and from the high pressure line by independent valves serving groups of nozzles. Admission of both high and low pressure steam is controlled by the one governing mechanism, which is so designed that the speed is practically constant under all changes of load and steam conditions. When the entire plant is in operation full output from the generating equipment is required; under this condition the two generators operate on the same bus with satisfactory results. During the working periods of the day there is now available almost exactly 1500 kw. of low pressure steam.


Two 3-drum sanders—Each driven by four motors

Low pressure steam for the turbine is taken from a receiver 5 ft. in diameter by 16 ft. long into which the engine room auxiliaries, as well as the three mill engines, exhaust. The condensing equipment consists of a No. 26 Wheeler Manufacturing Company's centrifugal jet condenser with a 14 in. double suction steam turbine driven tail pump and 9 in. by 22 in. by 16 in. dry vacuum pump. Water from the Fraser river is used for both the condensers and boilers. As a precaution the condensing equipment is of a design suitable for use with salt water.

The main exciter is a 50 kw. 125 volt Canadian General Electric machine operating at 300 r.p.m. and direct connected to a 10 in. by 12 in. Skinner centre crank engine. Another source of excitation is a 15 kw. generator direct connected to a vertical engine. The large machine is of ample capacity for both generators.

The electrical control is notably modern and well adapted for the requirements of this plant. The switchboard consists of eleven natural black slate panels, with a swinging bracket carrying the exciter voltmeter and synchrosope, and a F6 Tirrill regulator. Each main generator panel is equipped with three main ammeters, a voltmeter, a field ammeter and an indicating wattmeter. Each double circuit feeder panel, of which there are six, is equipped with two ammeters. All these instruments are of the horizontal edgewise pattern. On account of the high current capacity and low voltage, solenoid operated carbon-break circuit breakers, controlled by push button switches mounted on the panels, are used for the generators. These circuit breakers have a capacity of 3,000 and 1200 amperes respectively. The feeders are controlled by 500 ampere, automatic, hand operated, remote controlled oil switches. These switches and the solenoid operated circuit breakers are carried on a pipe frame work 5 ft. 6 in. behind the panels, the 480 volt bus being mounted on the same support above the switches. Inverse time limit relays are installed on all automatic circuits. Feeder cables through condulets enter conduit, and are carried down from the switches below the floor. The heavy cable is so arranged that it gives the installation an unusually symmetrical and pleasing appearance. The switchboard and control equipment were supplied by the Canadian General Electric Company.

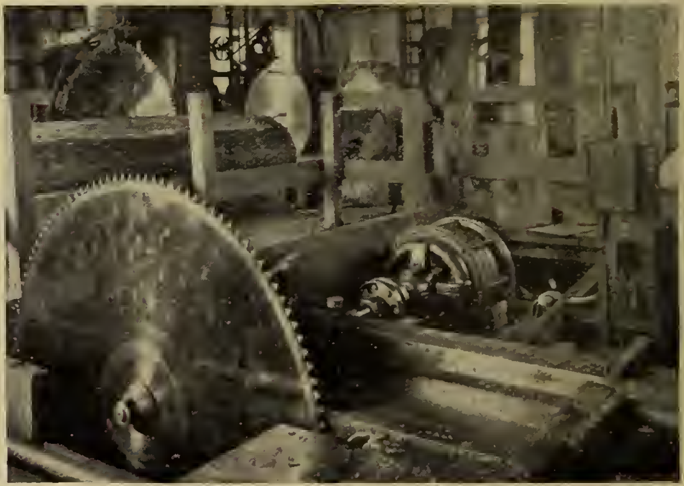
The Motors

The connected electrical horse-power in the various departments is as follows:—

Cedar sawmill	918.5 h.p.
No. 1 planing mill	917.5 h.p.
No. 2 planing mill	544.0 h.p.
Finishing shed	395.0 h.p.
Shingle mill	480.5 h.p.
Sash and door factory	315.5 h.p.
Veneer plant	153.5 h.p.
Isolated machinery and yard equipment .	571.0 h.p.
Plant lighting	207.0 h.p.
Town lighting	260.0 h.p.
Total	4,762.5 h.p.

The 200 motors in use vary in size up to 250 h.p. Motors of 100 h.p. capacity and below are of the squirrel cage type. All above this size, and those 100 h.p. units that are subject to heavy starting duty, are of a wound rotor slip-ring design. The system load-factor is approximately 80 per cent., and the ratio of average to connected load is practically 60 per cent. The planing mills, including 620 h.p. in fans, operate at a particularly high load-factor. Individual drives, through flexible couplings, either direct to the machine itself or its countershaft, are used exclusively except where fluctuating load conditions on several machines of a kind make grouping advisable to maintain a steady demand on the motor. The shingle machines, of which there are twelve, are driven in four groups by motors direct connected to the countershafts.

By constantly studying the operating conditions, and by redistributing the motors when necessary to ensure their operation at a maximum efficiency, an average power-factor of 82 per cent. was obtained on the original installation. It was realized, however, that if this power-factor could be improved, desirable operating advantages would be possible. A 350 kv.a. 480 volt, self-starting synchronous condenser with exciter, Tirrill regulator and control panel were installed in No. 1 planing mill at a point where it was considered that the power-factor corrective effect would be most beneficial. Under the same load conditions the effect of the condenser was to raise the system power factor to 94 per cent. The betterment in voltage regulation greatly improved the motor starting characteristics. The latter advantage was especially valuable in the planing mill where the motors have very severe starting duty. A duplicate condenser equipment has recently been purchased from the C. G. E. Co., and is being


Direct connected bolt saw, in shingle mill

installed in the cedar mill where it is expected to benefit operating conditions by compensating for the heavy load fluctuations on the 250 h.p. motor driving the 10 ft. double cutting band mill, as well as on the large motors driving the gang and edger.

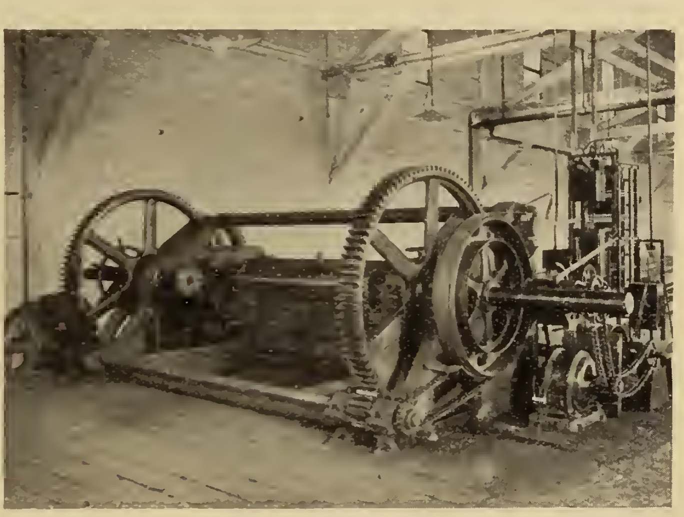
When the original motor installation was made, overload protection was provided by line fuses, and an automatic oil switch for each machine. The more recent purchases have called for these features embodied in the starter itself. These compensators have all the good features of the old combination, and some added refinements of design that are distinctly valuable. In this equipment are embodied protection to the motor from overload by series inverse time-limit relays, and against failure of voltage by a no voltage release attachment. The compensator itself is protected by a spring operated handle which makes it impossible for the attendant to leave the compensator switch in the starting position. The equipment is entirely self-contained; it is provided with dust protecting covers and arranged for the entrance of conduit from either the top or bottom. When it is found advantageous, in emergency or for other reasons, to have the attendant, at a point remote from the compensator instantaneously disconnect the motor from the line, a spring switch is installed in the no voltage release circuit of the compensator at this point.

A notable illustration showing the flexibility of the electric drive is the travelling derrick for handling heavy timber as it comes from the mill. This equipment was designed and built by the Canadian Western Lumber Company. The derrick, which consists of a mast supporting a counterweighted horizontal boom 107 ft. long, is mounted on a bed or carriage 40 ft. wide by 80 ft. long that operates on a four track runway extending 850 ft. from the end of the main sawmill, and at the same elevation as the mill deck. The main hoist, operated by a 40 h.p. slip-ring motor, has a lifting capacity of 7,000 lbs. at 150 ft. per minute. The lifting radius may be varied by a movable carriage on the main boom. This carriage is controlled by a 5 h.p. slip-ring motor. A 25 h.p. motor of the same type is used for swinging the boom, and operating the main carriage or bed. All motors are controlled from an operating turret mounted on the main carriage. A three-phase 440 volt trolley is strung at one side of the runway and the current collected by sliding contacts.

Sash and door factory containing 38 motor-operated machines

The Columbia three drum sanders show that the manufacturers of woodworking machinery fully appreciate the advantages of the electric drive. One 5 h.p. and four 7½ h.p. 1800 r.p.m. motors, with cloth pinions, are used on each of these machines, and belting is eliminated entirely.

Under normal conditions the entire plant is operated at the rate of 20 hours daily and for this reason the artificial interior illumination is an important consideration. A special three and four-light metal reflector has been designed and patented by Mr. Charles Rictor, the electrical superintendent, and this fixture with mazda lamps is used exclusively throughout. The combination provides a high illuminating efficiency, and occupies much less space than the metal troughs formerly in use, thus reducing the chances for the accumulation of dust.



Veneer machine operated by variable speed motor

The plant is completely wired in conduit, and the electrical installation conforms in every respect with the requirements of the Board of Fire Underwriters. Feeders from the power station run to slate distributing panels in each department. These panels are enclosed in steel cabinets. The outgoing circuits from the cabinets are fused and at every motor is installed a compensator, as previously described, or an automatic oil switch. All aerial lines are protected by compression chamber, multigap lightning arresters.

A study of the manufacturing results which are being obtained at this mill provides a most convincing argument for the use of electric drive in lumber plants. Almost every phase of the industry is represented at the Fraser Mills and every type of machine utilized is motor driven.

It is interesting to note that the Canadian Western Lumber Company was the first lumber concern in Canada to adopt the use of electric drive on a large scale, a departure which indicated a considerable degree of enterprise, and one which is thoroughly deserving of the commendation of the electrical profession as a whole.

The fact that during the five years of its operation there have been practically no shut-downs in this plant on account of electrical troubles is striking evidence of the foresight and intelligence displayed in arranging and operating the equipment, and also speaks highly of the managing and operating staffs which consist of: Mr. A. D. McRae, vice-president and managing director; Mr. J. D. McCormack, secretary-treasurer; Mr. W. S. Rogers, manager of manufacturing; Mr. Chas. Rictor, electrical superintendent.

The city of Winnipeg have awarded a contract to the Siemens Company of Canada for one 500 kw. motor generator set. This is the third set of this size supplied by the Siemens Company to the city of Winnipeg. The motor will be of the self-starting synchronous type, 720 r.p.m., 3-phase, 60-cycle, 2200 volts, direct coupled to a compound-wound, 3 wire, 550/605 volt generator with commutation poles. The contract also includes a direct connected exciter together with shunt and series rheostats and motor starter.

The Closer Regulation of Transformers

By Mr. H. B. Dwight

It is a fact of common observation in electrical engineering that less importance than formerly is being placed on obtaining very close regulation of transformers. A number of years ago every effort was made to secure transformers with as small a percentage of regulation as possible. This was valuable since most transformers supplied lighting loads, and poor transformer regulation produced variations in voltage. At the present time, a constant voltage at the load is just as desirable as ever, but this is not often primarily dependent on the transformer regulation. The average power-factor is lower, due to the increased use of induction motors, and power is distributed to longer distances, and thus the use of potential regulators has become general for providing steady voltage for power users. Therefore, even in local distribution of power, transformers with close regulation are not required as much as formerly.

In large power transformers, close regulation means low reactance, which is now commonly regarded as a distinct disadvantage and source of danger, due to the destructive action of the very large currents which flow when a short-circuit occurs.

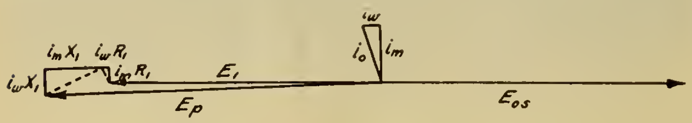


Fig. 1—Transformer vector diagram at no-load.

No matter what percentage of regulation is desired, however, it is quite important to determine the regulation of a transformer accurately. Most manufacturers guarantee a certain regulation for lighting and power transformers. The accurate determination of the regulation and impedance is also required where different transformers are to operate in parallel. The exact formula for calculating transformer regulation from test results, taking complete account of magnetizing current, etc., was carefully worked out some years ago, and is understood and followed to a considerable extent. However, the formula is very seldom published, and not all of the books are in agreement with it, but contain an older inaccurate formula. Accordingly, an explanation of this matter may prove of interest.

According to the Standardization Rules of the American Institute of Electrical Engineers, the regulation of a constant-potential transformer is "the ratio of the rise of secondary terminal voltage from rated non-inductive load to no-load, at constant primary impressed terminal voltage, to the secondary terminal voltage at rated load."* It is therefore necessary to calculate the secondary voltage at both full-load and no-load for a certain constant value of primary voltage. This can be done very easily by consideration of the vector diagram of a transformer (Figs. 1 and 2).

At no-load (Fig. 1), the secondary winding of the transformer is open-circuited, and no current flows in it. However, a current, i_o, called the exciting current, flows in the primary winding. If E_p is the voltage impressed on the transformer, the component i_w, of the current i_o, which is in phase with E_p represents true power delivered to the transformer. This power is called the iron loss of the transformer. The component of current in quadrature with the applied voltage E_p is i_m, the magnetizing current.

If R_1 and X_1 are the resistance and reactance of the primary winding alone, a voltage drop proportional to them and to the no-load current will be produced in the winding. The voltage, E_1, induced in the primary winding by the transformer flux will therefore be less than E_p by the amount of this drop, as is shown in Fig. 1. Thus we have:

$$E_1^2 = (E_p - i_w R_1 - i_m X_1)^2 + (i_w X_1 - i_m R_1)^2$$

or, since all the quantities are small compared with E_1 or E_p, we have, to a very close approximation,

$$E_1 = E_p - i_w R_1 - i_m X_1 + \frac{(i_w X_1 - i_m R_1)^2}{2(E_p - i_w R_1 - i_m X_1)}$$
$$= E_p - i_w R_1 - i_m X_1$$

since the last term is quite negligible in a practical case.

When a load is connected to the transformer (see Fig. 2), a current I_s at a lagging power-factor, cos θ, flows in the load and in the secondary winding. Let P be the component of load current in phase with the secondary terminal voltage E_s, and let Q be the lagging reactive component. These currents will produce a drop in the secondary winding so that the voltage induced in the secondary winding will be larger than E_s and will be equal to E_2, where

$$E_2^2 = (E_s + P R_2 + Q X_2)^2 + (P X_2 - Q R_2)^2$$

The same voltage, multiplied by the ratio of turns, is induced in the primary winding, and is E_1. The current flowing in the primary winding is made up of a current whose ampere-turns will exactly balance, both in phase and magnitude, the ampere-turns of the secondary current, and an additional current necessary to magnetize the transformer and supply the iron loss. It may be assumed that this additional current is made up of i_m and i_w, the same as at no load, and that they are in phase with Q and P respectively. The error involved in this assumption will be exceedingly small, as is mentioned later. Then, referring all quantities either to the primary or secondary by means of the ratio of turns, and letting $R = R_1 + R_2$ and $X = X_1 + X_2$ we have

$$E_p^2 = (E_s + PR + QX + i_w R_1 + i_m X_1)^2 + (PX - QR + i_w X_1 - i_m R_1)^2$$

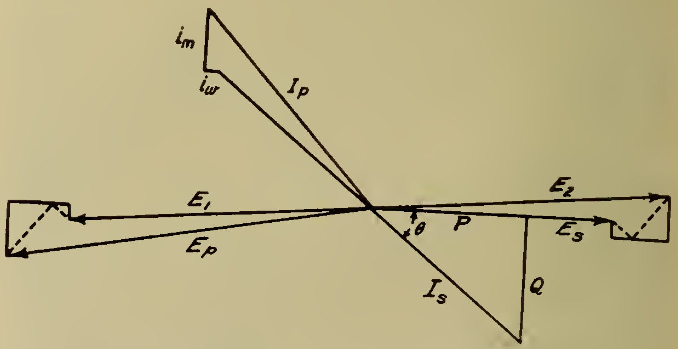


Fig. 2—Transformer vector diagram at full-load.

Thus, to a very close approximation,

$$E_p = E_s + PR + QX + i_w R_1 + i_m X_1 + \frac{(PX - QR)^2}{2 E_s}$$

$$\text{or, } E_s = E_p - PR - QX - i_w R_1 - i_m X_1 - \frac{(PX - QR)^2}{2 E_s}$$

Now from Fig. 1, the no-load secondary voltage is

$$E_{os} = E_p - i_w R_1 - i_m X_1$$

The regulation is

$$\frac{E_{os} - E_s}{E_s} = \left\{ PR + QX + \frac{(PX - QR)^2}{2 E_s} \right\} \frac{1}{E_s}$$

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* Trans. A.I.E.E., 1911, p. 2553, par. 197.

or, if R and X are the percentage resistance and reactance drops, and P and Q the power-factor and reactive factor of the load, expressed in decimals, then the regulation is

$$PR + QX + \frac{(PX - QR)^2}{200} \text{ per cent.}$$

This is the standard formula for transformer regulation by test measurements, and it is mathematically correct, including all effects of magnetizing current, etc., to a greater degree of accuracy than is found in test measurements or slide rule calculations. This statement is checked up by calculating out in detail the example given with this article. The effect of the approximations is seen to be negligible.

A formula has been published and is still sometimes put forward, which contains errors that are not negligible, though apparently an attempt has been made to make the formula exact. It is as follows:

$$\text{Regulation} = PR + (Q + i_m)\,X + \frac{[PX - (Q + i_m)\,R]^2}{200}$$

where the various quantities are expressed as percentages and are all referred to either the high tension or low tension. There are two obvious errors in the above formula: first, i_m should never be multiplied by X but only by X_1, the primary reactance, which is approximately equal to ½ X, and second, since i_m is present at both no-load and full-load, it has no appreciable effect on the regulation, which is the difference between no-load and full-load conditions. Along with the above formula there has been given the instruction to divide the result by the quantity (1 + Reg'n.) in order to obtain a final corrected result. This is not correct, for the regulation should be expressed as a percentage of the secondary full-load voltage, as is done in the standard formula derived above.

The following short example illustrates the procedure in using the standard regulation formula: rating of transformer, 100 kv.a., single phase, 100 amps., 1000 volts (i.e., secondary full-load voltage = 1000): total resistance referred to secondary, 0.08 ohms; percentage resistance drop, R = 0.8 per cent.; total reactance referred to secondary, 0.5 ohms; percentage reactance drop, X = 5 per cent.; iron loss, 700 watts = 0.7 per cent.; magnetizing current, 6 amps. = 6 per cent.

Find the regulation at 80 per cent. power-factor of load.

$$P = 0.8$$
$$Q = 0.6$$

$$\begin{aligned}\text{Regulation} &= 0.8 \times 0.8 + 0.6 \times 5 + \frac{(0.8 \times 5 - 0.6 \times 0.8)^2}{200} \\ &= 0.64 + 3.00 + 0.06 \\ &= 3.70 \text{ per cent.}\end{aligned}$$

According to the incorrect formula given above,

$$P = 0.8$$
$$Q = 0.6 + 0.06 = 0.66$$

$$\begin{aligned}\text{Regulation} &= 0.8 \times 0.8 + 0.66 \times 5 + \frac{(0.8 \times 5 - 0.66 \times 0.8)^2}{200} \\ &= 0.64 + 3.30 + 0.06 \\ &= 4.00 \text{ per cent.}\end{aligned}$$

Thus the error is 0.30 per cent. of rated voltage, which is quite noticeable. The error due to dividing this quantity by 1.04 is also seen to be considerable.

That the assumptions involved in deriving the standard regulation formula are of negligible effect may be seen from the following detailed calculation of the same example. At full-load, we have

$$\begin{aligned}E_p^2 = {} & (E_s + PR + QX + i_w R_1 + i_m X_1)^2 \\ & + (PX - QR + i_w X_1 - i_m R_1)^2\end{aligned}$$

$$\begin{aligned}E_p &= 1000 + 6.4 + 30 + 0.028 + 1.50 \\ &\quad + \frac{(40 - 4.8 + 0.175 - 0.24)^2}{2 \times 1038} \\ &= 1037.93 + 0.59 \\ &= 1038.52\end{aligned}$$

If we neglect the effect of the exciting current in the last term, and use the round number 1000 in its denominator, as is done in the standard formula, we obtain

$$\begin{aligned}E_p &= 1037.93 + \frac{(40 - 4.8)^2}{2 \times 1000} \\ &= 1037.93 + 0.62.\end{aligned}$$

The difference is 0.03 volts or 0.003 per cent. of rated voltage, which is negligible.

At no-load, keeping E_p equal to 1038.52, we have

$$E_{os}^2 = (E_p - i_w R_1 - i_m X_1)^2 + (i_w X_1 - i_m R_1)^2$$

$$\begin{aligned}E_{os} &= 1038.52 - 0.028 - 1.50 + \frac{(0.175 - 0.24)^2}{2 \times 1037} \\ &= 1036.99 + .000002.\end{aligned}$$

The last term is seen to be entirely negligible, as was stated in the description of the no-load diagram. The regulation is equal to

$$100\,\frac{E_{os} - E_s}{E_s} = \frac{1036.99 - 1000}{10}$$
$$= 3.70 \text{ per cent.,}$$

as was obtained by the standard formula. The other approximations produce differences of the same small order of magnitude as those shown above.

Battery Charging by Motor-Generator

One of the big factors to be considered in the purchase of an electric vehicle is the charging of the storage batteries. Up to the present time this charging operation has been attended to, for the most part, either in the ordinary gas car garage or by the central station owner who has installed special equipment for the purpose. Nearly all electric supply is alternating current and as batteries can only be charged with direct current it has been necessary to install equipment to change the alternating current to direct. As this equipment is somewhat expensive and as its operation calls for more or less technical knowledge, it has not been possible for the vehicle owner to install it, in his own garage, the necessary equipment for charging his batteries.

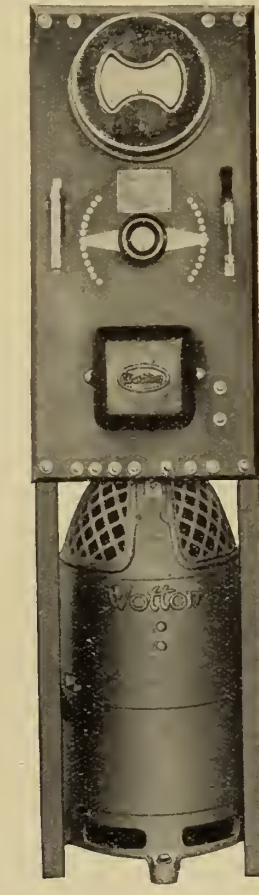
There may be said to be four general methods of rectifying an alternating current. These are, first, by chemical means such as the aluminium cell; second, mechanical means as, for example, the synchronous commutator; third, electro-chemical rectification of which the mercury arc bulb is the commonest example; fourth, magneto-mechanical means of which the commonest is the motor-generator set. In the recent past the equipment most generally used in small capacity work is the mercury arc rectifier, but there has recently been placed on the market by the Electric Products Company of Cleveland, through their Canadian agent R. E. T. Pringle, a vertical type of motor generator-set which is claimed to be suitable for small individual garages and to overcome many of the difficulties experienced with other types of rectifier. Regarding the vertical type machine the manufacturers have this to say:—

"Broadly speaking, for battery-charging purposes the ideal machine would first be vertical instead of horizontal. This conserves floor space, where, in most instances, it is of much value and convenience. This type also eliminates the component gravity and centrifugal forces, and the result is a more perfectly balanced machine, as, in the vertical type, the dead weight, or gravity force, is applied at the center of the shaft, and, therefore, does not affect the centrifugal forces of rotation.

Lubrication is a prime necessity. In the hands of the typical woman operative, no attention will be given to lubrication. This element of design must have the same margin of safety built into it as is found in her car. Bearings must, therefore, be automobile type ball bearings, running submerged in oil. Otherwise, frozen bearings are sure to follow, dust and foreign substances are sure to enter.

It is not necessary to consider the matter of speed reduction, as these machines are not applied to driving machine tools. Highest efficiency can be secured in higher speeds than those commonly found. Space and weight decrease as speed increases. The speed shall be as high as good engineering considerations will permit. Commutator velocities largely govern this. This must not exceed 5,000 ft. per minute, which is good turbo-generator practice.

A machine of this type, in the generator end, should have an inherently flexible variation of characteristic to adapt itself readily to either constant current or tapering charging rates, according to the type of battery to be charged.



Vertical type motor-generator set.

This ideal vertical rectifier has three disadvantages:

1. A higher manufacturing cost.
2. A lower electrical efficiency.
3. Renewals to brushes, bearings and oil occasionally.

But to offset these disadvantages this high-speed vertical rectifier presents:

1. A very high commercial efficiency. This applies to all voltages, being practically constant throughout the entire voltage range.

2. A flexible voltage range. Field resistance regulation in a direct-current generator is extremely flexible and the losses are exceedingly slight.

3. A standard type of apparatus that every electrician understands. This results in quick repairs and few operating interruptions.

4. Close regulation at variable line voltages. The speed of an alternating-current motor depends upon the frequency of the supply current rather than the voltage. As the voltage varies, however, the slip of the motor below its synchronous speed varies almost in proportion to the variations of voltage. The direct-current voltage varies directly as the speed of the motor. Therefore, fluctuations of the supply alternating-current line voltage will affect the direct-current voltage, and, therefore, the charging rate to a less degree than is found in any other commercial machine built. Plate 5 shows the true regulation of the ideal rotary rectifier.

5. Automatic restarting is easily accomplished through simple solenoid switching devices that have become standard in thousands of different industrial applications.

6. A very flexible adjustment for tapering or constant-current charging rates. In commercial vehicle applications, especially, this is an enormous advantage. Under ordinary circumstances, for a lead battery it would be desirable to allow the regular charges to proceed at tapering rates throughout the charging process. During times of emergency, and after battery capacity begins to materially lessen, it will add greatly to the usable life of that battery to be able to give it a constant-current boost during spare hours of the day.

Therefore, to sum up the relative value of the various types of rectifying apparatus for use in unattended garages, where simple and dependable operation is of first importance, and a high commercial efficiency is equally desirable, there can be little discretion as to the relative merits of a motor-generator, designed after these lines and that of any other afore-mentioned types.

Uninterrupted service first, then economy, is the order in which the importance of these varied machines must appear to the owner of the unattended garage."

A very important feature of the new machine is its control, by an instrument of the voltmeter type and to which the name, on account of certain characteristics, Soakometer has been given. This meter is shown at the upper part of the accompanying illustration and carries two graduated scales. The lower scale is for reading volts and amperes, the latter being accomplished by simply pressing a button which cuts out the high resistance of the voltmeter. On this scale there is also a second indicator or pointer which moves concentrically with the indicator and is set, for the average charge, a little below the absolute maximum, which is determined by test and checked with the gravity readings. On the rear end of each of these pointers on the lower scale there is located an engaging contact and the coincidence of these pointers, brought about by the voltmeter needle gradually rising, allows a current to flow and sets a clock work in motion. The clock work is situated in the upper part of the meter and the pointer shown on this upper scale is simply the hour hand of the clock. As the clock operates this hand moves slowly across the scale from left to right and on reaching the extreme right hand side finally engages a contact which operates the main line circuit breaker and cuts off the current. This clock hand may be set at any point in the scale so that, in actual operation, any time from the maximum down to zero may elapse between the instant when the two lower hands first come together and the instant the current is finally shut off. This latter time element during which the cells continue to be charged after the maximum voltage has been reached, in other words during which time the soaking charge is being given to the cells, is the origin of the name given to the instrument.

In addition to this special and valuable feature it is pointed out that a short circuited cell is also indicated by the failure of the two lower pointers to engage, and while this at first sight would appear to be a defect in the instrument it has proved one of its most valuable points.

Testing of Telephone and Telegraph Lines*

By Mr. T. H. Nicholson

Line Testing With a Voltmeter (con.)

The circuits shown on Figs. 17, 18 and 19 are equally applicable to ballistic tests, that is, to note the presence or absence of capacity. To ascertain this on L_2 the "VM" key is operated and released and the temporary deflection noted, which is the capacity from L_2 to ground which might be a condenser at "X." The same is true of L_1 except that for this test both the "VM" and "reverse" keys are operated, but only the "VM" key released to note the capacity deflection. For observing the capacity across the line, or between the wires L_1 and L_2, the "VM" and "ground" keys are operated, and the "reverse" key alternately operated and released to get the deflection.

In addition to these three fundamental tests the keyboard is usually arranged to permit of the telephone circuit being connected onto the line when desired. Keys are also provided to use a shunt coil, or to cut out the testing battery in order to observe foreign potentials. The use of these is similar in all important respects to like functions of another test circuit of different principles to be later described, so no effort will be made to detail them here.

Nearly all testing keyboards designed on the principle outlined above are so arranged that when the key, or combination of keys, for any particular test is operated the rest of the circuit is cut off. This is in order that no confusion can occur by throwing two or more distinct tests together. This feature is of value when those using the circuit are not very familiar with it, but on the other hand it is a serious drawback to a good testman who thoroughly understands the arrangement, and who may be able to combine tests and thus save time, or duplicate conditions not otherwise possible.

Then, the use of a grounded voltmeter is occasionally a drawback, as, for instance, when it is desired to measure the loop resistance of a line that is grounded on one side. This is clearly illustrated in the example of trouble locating given with Fig. 20, where, after measuring the resistance on each side of the line to the cross, it was desired to measure the line itself to check with the apparent resistance derived from the two single measurements. Obviously this cannot be done, and the only alternative available, failing a definite record of the line, would be to measure with a bridge.

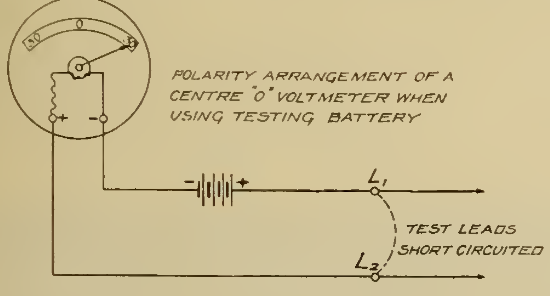

POLARITY ARRANGEMENT OF A CENTRE "O" VOLTMETER WHEN USING TESTING BATTERY
+
-
+
L_1
TEST LEADS SHORT CIRCUITED
L_2

Fig. 21

Universal Testing Circuits

It will be assumed in the following explanation of universal testing circuits that the reader has to do with telephone systems using a three-wire circuit in the central office part of the subscribers line, that is, a pair of wires for the talking circuit, and a single wire, usually associated with the pair, for controlling the line relay, or other signalling apparatus, and to provide means of obtaining a busy test. The testing circuits can be more conveniently shown under these conditions and it is not a difficult matter to apply the methods outlined to systems using two wires only. These three wires will be spoken of as L_1, L_2 and L_3, corresponding to tip, ring and sleeve, or line, return, and test, as the case may be. This point should be thoroughly understood, and proper definitions made when applying circuits or methods given to actual conditions, for the reason that the accuracy, and sometimes the very operation, will depend upon the correct relation of the several wires.

The circuits to be described are called universal for the reason that by a correct manipulation of keys any known test can be made on a line without any further change in the arrangement. Usually a testboard is so arranged that only a few tests can be made with any one of the several test cords. If a voltmeter test is required then the voltmeter cord is used, and so on, but with this arrangement it is possible to take up a line with the one test cord and make all the tests that are provided in the complete circuit. This has, incidentally, an appreciable value on routine testing alone, especially in these days when more attention is paid to anticipating trouble than formerly, and the extent of this anticipation is largely governed by the ease and quickness with which tests can be made, and consequently by the facilities at hand.

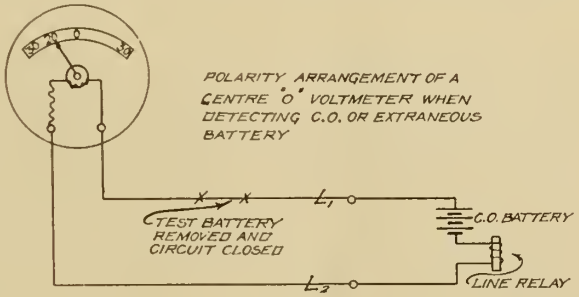

POLARITY ARRANGEMENT OF A CENTRE "O" VOLTMETER WHEN DETECTING C.O. OR EXTRANEOUS BATTERY
L_1
TEST BATTERY REMOVED AND CIRCUIT CLOSED
C.O. BATTERY
L_2
LINE RELAY

Fig. 22

The requirements for these testing circuits are such that the grounded voltmeter had to be abandoned and also, with it, the system of having each distinct test cut off all others, except, of course, in such instances where there is no advantage to be gained by making them together, or where awkward or perhaps dangerous conditions might result from throwing them together.

It has been found by experience that a voltmeter of the center "O" type is the best for these testing circuits, and that a 30-volt testing battery is sufficiently high for local line testing. It is also known that the most accurate results are obtained when the voltmeter has an internal resistance not much greater than the highest resistance to be measured. The average insulation trouble is not much higher than 3000 ohms, so a voltmeter having approximately this resistance is accurate enough for all practical purposes. This is specially mentioned because voltmeters of this type and range usually calibrate with a resistance around this figure, and it is therefore unnecessary to go to the expense of having an instrument designed to calibrate to any definite resistance.

The center "O" type instrument is used for several reasons. The most important of these is that the polarity of any current causing a deflection is immediately known, and without the necessity of consulting the keyboard. This is useful when dealing with extraneous currents, or when measuring or detecting the central office battery. The circuit is

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* Copyright in Canada, United States and Great Britain.

arranged so that the testing battery is always used with its negative pole connected directly to the negative side of voltmeter, and as nearly all central office batteries have their live side negative, the testing battery always gives a positive or right hand deflection, and the central office battery a negative or left hand deflection.

Fig. 21 shows the schematic design of a voltmeter circuit of this type with the test leads short circuited, thus giving a full scale deflection in the positive direction and indicating a closed circuit without any appreciable resistance in the test leads. Fig. 22 shows the same voltmeter with the test battery removed and the circuit closed through to the test leads. In this case there is a deflection of 20 which simply means there is 20 volts at the test lead terminals, but does not indicate what the full voltage of the source of current is, nor the resistance of the circuit over which it is being observed. If it is known however, by other tests that this is the central office battery, then the resistance in the circuit can be determined in the same manner as would be followed if it was the testing battery itself, and assuming it to be 24 volts and the voltmeter 1000 ohms, the resistance must be, from the formula before given:—

$$\frac{D \times V}{d} - V = \frac{24 \times 1000}{20} - 1000 = 200 \text{ ohms.}$$

If there is any doubt that it is the central office battery, then it must be determined by a Wheatstone bridge method (to be later described) by which the resistance can be first determined and from that the voltage obtained through it.

It is fairly standard practice in telephone systems to have the negative or live side of the central office battery connected to the L_1 or ring side of the line; for this reason the positive pole of the voltmeter is connected to the L_1 side of the test circuit and the negative side to the negative side of the test battery, with the positive side of the test battery connected to L_1 of the test leads, thus making it unnecessary, as before explained, to reverse the test leads in order to make any test or measurement. An exception to this will sometimes occur when the voltages greater than the range of the voltmeter are encountered, as for instance when measuring the extra, or booster, battery used for toll work. As this battery is also negative on the L_1 side it can be measured by leaving the 30 volt test battery in circuit and noting the negative deflection with the two currents opposing; this may be up to 18 volts depending on the amount of resistance in the circuit. Some other instances develop which will occur as the explanation of circuits and methods proceeds.

Personals

Hon. Adam Beck sailed for England during the second week in December per s.s. Olympic.

Mr. J. Sanger, late superintendent of distribution for Light and Power Department, Winnipeg, has accepted a position with the Winnipeg Branch of the Siemens Company of Canada, Limited.

Mr. J. B. Sunderland is severing his connections with the British Columbia Electric Railway Company, with which he has been connected for the past five years, filling an important post in the comptroller's department.

Mr. Th. Seidl, manager and chief engineer of Messrs. Escher Wyss & Company, Montreal, started on a short trip to Switzerland on the 16th December. Mr. Seidl expects to be back in Montreal on 20th January. During his absence Mr. Withers will be in charge of the office.

Mr. C. B. Vorce, who has for the past three years occupied the position of construction engineer with the British Columbia Electric Railway Company, recently severed his connection with that concern. During his residence on the coast Mr. Vorce has ably carried out the exceptionally heavy duties devolving upon him because of the large amount of construction and maintenance work which his company was compelled to undertake. He leaves Vancouver after having won golden opinions both from the engineers with whom he has been associated, as well as the business men with whom he came in contact. It is probable he will utilize his engineering ability and experience in consulting engineering work in New York.

Mr. W. C. Gordon has been appointed Transportation Engineer for the Canadian General Electric Company, Limited, and will take charge of all inquiries in connection with electric traction. He has wide experience in connection not only with city and interurban electric traction, but also trunk line electrification. After graduating from Cornell in electrical engineering in 1899 he entered the testing department of the General Electric Company at Schenectady. While in the Railway Construction Department he had charge for the General Electric Company of the installation of the first electrically operated train on Manhattan Elevated, New York, and later of the installation of the first multiple unit equipments for the Northwestern Elevated Chicago, Aurora, Elgin and Chicago Railway, Lake Shore Electric Railway, etc. Later while in the Railway Engineering Department at Schenectady he was closely associated with the further development of multiple unit operation for the New York Central lines and the Interboro Rapid Transit Company. He later went to Australia in the General Electric Company's railway interests and was manager and engineer of the North Melbourne Tramways and Lighting Company, Limited; later he was engineer for the National Electrical and Engineering Company, Limited, handling the New Zealand business for the General Electric Company and, finally, engineer for the Brisbane Tramways Company, Limited, until his return to Canada. Mr. Gordon is a son of Principal Gordon, of Queen's University, Kingston.

Trade Publications

P. & S. Equipment—bulletin 829, issued by Pass & Seymour Inc., describing, with complete illustrations, their handy electrical wiring devices.

House-Number Condulets—A pamphlet issued by the Crouse-Hinds Company of Canada, describing and illustrating this new type of condulet.

Stock List—Issued periodically by the Crouse-Hinds Company of Canada containing a list of material or parts which can be shipped immediately upon receipt of order. The latest list deals with panel boards and cabinets.

Storage Batteries.—Bulletin No. A4131 issued by the Power & Mining Department of the Canadian General Electric Company describing storage batteries, industrial and mining locomotives. The bulletin is well illustrated and some interesting figures are given on the design and operating costs of this equipment.

Cedars Making Good Headway

The Cedars Rapids Manufacturing & Power Company have just issued their second report on work completed to date December 1, 1913. Splendid construction progress has been made as is shown by the fact that concrete work in the power house is completed for three of the ten units and partially completed for the others. Three turbines and three generators are already on the ground and it is expected that the work of erection of these will be commenced about the first week in the new year. The report is illustrated with very interesting construction views, one of which shows the large movable cantilever crane used in placing the concrete, etc.

Illumination

Street Lighting of Westmount

The city of Westmount, P.Q., have recently improved their system of lighting by installing 50, 6.6 ampere magnetite arc lamps, supplied by the Canadian General Electric Company, on Western Avenue. This type of lamp and the mercury arc rectifier equipment were fully described by Mr. L. Burpee in our issue of October 15.

Western Avenue is over a mile in length, and lends itself to an effective system of lighting. It is now the best lighted thoroughfare either in Westmount or Montreal, the difference between the old system of 4 amp. arc lamps and the present system being very marked. The work was done under the supervision of Mr. G. W. Thompson, the general manager, for the City Council, the owners of the civic lighting plant.

The lamps are installed on ornamental standards, spaced approximately 230 feet apart on both sides of the avenue, with a lamp at the corner of every block. The globes surmounting the standards are heavy opal. The globes at the corners have the names of the streets painted on them. The current is supplied by means of underground cables.

The latest type of mercury arc rectifier is installed in the power house, together with a spare unit, for use in case of necessity.

The city have constructed a trunk line of conduits on Western Avenue, from the city limits on the east to the city limits on the west. The purpose of the system is to take care of all companies through cables and the police call and fire alarm systems. It is proposed to gradually extend the conduits so that all main feeders will be placed underground, thus enabling all poles to be removed with the exception of lamp poles. In Western Avenue the poles will be entirely abolished, the Bell Telephone Company having constructed their own conduits on this thoroughfare.

The Westmount Council have further improved the light- of the city by installing 55 on-light 150 watt tungsten standard lamps in Westmount Park. Armored cable, placed underground, carry current to these lamps.

Over-Head Lighting for Industrial Purposes

By Mr. J. L. Stair

Generally speaking, for shops and factories two classes of lighting are resorted to, i.e., the general system and the localized system. In the one case the lamps are mounted above the heads of the workmen giving a uniform lighting in all parts of the room, and in the other case individual lamps on drop cords or brackets cause a strong light to fall upon the work, leaving the rest of the room in comparative darkness. Since there are very few instances in which local lighting is necessary, the general over-head system will fulfill most of the requirements of good lighting, and do it economically.

Of the many advantages of the over-head system of lighting, the following are probably the most manifest. To begin with, the room with an absence of drop cords presents a very clean cut appearance, and in many cases an unobstructed view may be had form one end of the room to the other. This system also adds a cheerful appearance to the room, since the whole area is uniformly lighted. It also makes available for working purposes every square foot of floor space. The workman for whom the lighting is really intended receives the greatest benefit, the light reaches him from several directions and the lamps, being out of the range of vision, add to his ocular comfort and eliminate the glare which is considered the most dangerous feature of modern illumination. The workman saves time in looking for tools, and the annoyance of handling and adjusting the drop cords is done away with. As a result of all this he can turn out a better product with a smaller percentage of spoilage.

The many advantages of good illumination can be easily secured by the correct application of a few simple principles. Though these principles have been laid down many times before, they are nevertheless frequently lost sight of before

Western Ave., Westmount—Twilight scene.

Western Ave., Westmount, by day.

the lighting equipment is finally selected and installed. We should keep in mind then in the solving of shop lighting problems, the following:

tt(1) Shield the light source and keep it out of the range of vision.

(2) Provide plenty of light.

(3) Give the light proper direction.

(4) See that the light is properly diffused.

(5) Keep the system up to its original standard of efficiency.

All of the above are to be accomplished in the most economical way as regards current consumption, first cost of wiring and installation, and maintenance expense. A little careful planning and supervision will greatly simplify the working out of the lighting for seemingly complicated requirements. Select the proper size of lamp for your needs; obtain reflectors that will most efficiently reflect the light and protect the lamp; determine with great care the location of the lighting units, their height and distance apart; and establish a regular schedule for the cleaning and renewing of the equipment—you will then have accomplished practically all that is embodied in the five essentials above.

The satisfactory character of the results obtained by the over-head system of lighting for shops, is shown by the illustrations herewith. Attention is called to the evenness of illumination, distinctness of detail, the clean cut appearance of the rooms and lack of glare from light sources. The work room shown in Fig. 1 illustrates a most efficient use of every square foot of floor area, with the consequent necessity for an equally efficient lighting system. As a matter of engineering information it may be noted that the reflectors are arranged on 10 ft. centres in rows 11 ft. 3 in. apart; the distance from the floor to the lamps is 11 ft.; and the work tables are 32 in. high. Each lamp and reflector unit supplies eight men with adequate illumination at an expenditure in wattage of about .66 watts per square foot.

The writer has in mind an excellent illumination effect, using a similar system to that in Fig. 1. in a woodworking factory and we quote the words of the engineer of the plant:

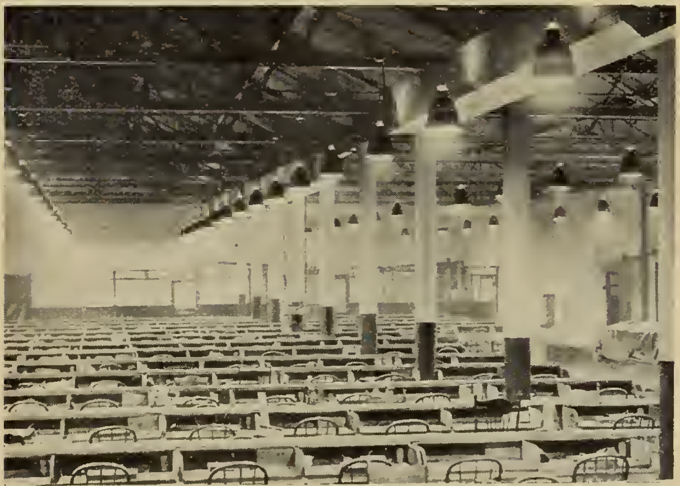


Fig. 1—Overhead lighting in work-room.

"This room is 116 ft. long, 50 ft. wide, and 13 ft. high. The roof is inclined, so that it is 12 ft. on one side and 14 ft. on the other. We have forty 100-watt lamps in reflectors placed on 10 ft. centres, 9 ft. above benches. Before installing the over-head system of lighting, each bench and its table had three small 16 c.p. lamps. These, aside from the annoyance due to handling, were unsatisfactory in the lighting. There is not a single light now used other than the ceiling reflectors. This effects a very material saving, as each workman was compelled to adjust his lamps to every new position he assumed. This required time, and as each man had three lamps they were quite busy adjusting lights."

In a great many shop installations it is necessary to light very thoroughly the vertical surfaces of machines and work. This can best be accomplished by the installation of reflectors similar to that illustrated in Fig. 2. A system of this character, as well as lighting the vertical surfaces, also provides a good uniform illumination on the floor and on horizontal surfaces. The reflectors installed in this case are non-symmetrical in their design, and are so constructed as to direct most of their light at an angle rather than in a downward direction. They are placed in rows, the individual reflectors being about six feet apart.

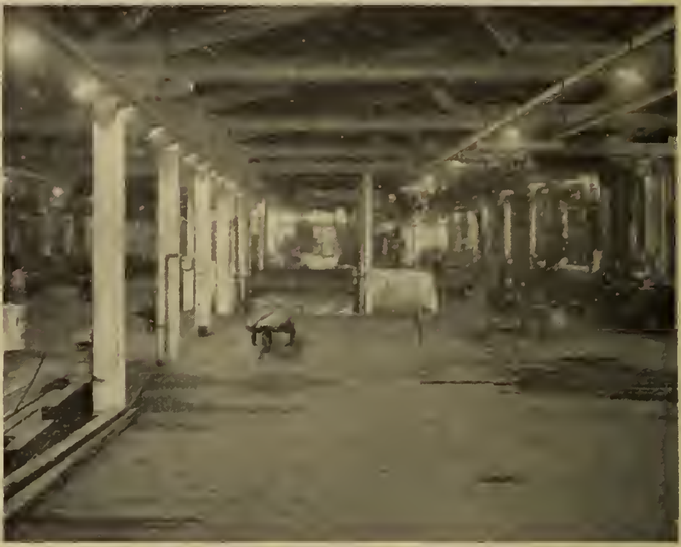


Fig. 2—Illuminating vertical surfaces.

As stated above, the placing of reflectors and lamps, has an important influence on the uniformity and direction of the light received by the workman. A symmetrical arrangement of units as shown in Fig. 1, has the outlets spaced an equal distance apart. Each lamp and reflector takes care of a certain square area and the total result is a uniform illumination, that is, if the intensity of light were measured on the floor it would be nearly equal in all parts of the room. This symmetrical arrangement is ideal for shops or work rooms in which the character of the operations or work is much the same. In the case of the work room illustrated, it was necessary to provide a uniform arrangement of outlets, because of the close seating of the workmen. In other cases a more or less grouped arrangement of lamps has to be adhered to, that is, a number of reflectors are placed above a group of machines or benches, and the system of squares described above for Fig. 1, is not carried out. The arrangement in many cases is affected by the presence of over-head shafting and belts. An advantage of this grouping, is, that it provides the greatest intensity of light where it is most wanted. This system is used extensively in shop lighting and is a good one to follow where a diversity of processes or operations are being carried on, which may require varying intensities of illumination. In a general over-head lighting system the units should be placed well above the plane or work to be illuminated, and the most efficient reflectors installed to throw the light down where it is needed.

A provisional agreement has been made between the town council of Barrie and the Toronto, Barrie & Orillia Electric Railway Company. The first section of the road is to connect Barrie with a point on the C. P. R. at Midhurst. Work on this section is to commence not later than April 16, 1914.

Electric Railways

Latest Practice in Street Railway Lamps

By Mr. J. L. Staley*

Before attempting to describe the present practice in street railway car illumination it is useful to make a brief review of past practice. In the past, 64-watt carbon lamps of approximately 16 candle-power, operating at an efficiency of about 4 watts per candle were commonly used. These were 105 to 130-volt lamps operated five in series on circuits of 525 to 650 volts. Three, four and five circuits, of five lamps each were commonly used, the number of circuits depending on the size of car, the various forms of grouping and general arrangement, such as clusters of fives or double rows of single lamps.

The 42-watt lamp of approximately 10 candle-power was used by a few railways, while the 114-watt lamp, giving approximately 32 candle-power, was sometimes used where more illumination was required, or where it was felt that the saving in the number of sockets employed would justify a larger lamp.

The carbon street railway lamp, however, had certain limitations. It was found that, with the increase in street railway schedules due to the growth of any community, there was at certain rush hours a drop in voltage, which, with carbon lamps, made a very marked decrease in resultant illumination. While these rush hour periods were of short duration, they unfortunately occurred at a time when street railway companies were attempting to serve the greatest number of people. During these rush hours the motors were operating satisfactorily, although not quite as efficiently, and as speed was not so important at this time, the railway companies did not feel justified in increasing the feeder capacity to take care of lighting alone. There was therefore need for a lamp of better regulation, that is, one which would maintain more nearly constant candle-power over a wide range of voltage.

Aside from the fact that more nearly constant illumination was desirable, the increase in the standard of illumination throughout the country in all places where artificial illumination was used, such as the home, factory, street, etc., made it also desirable to increase the illumination in the car. That is, illumination which a few years ago was considered adequate, today would not meet with public approval.

The inherent regulation of the mazda lamp, i.e., increase in resistance with increased voltage tending to check an increase in current, together with its high efficiency showed that this class of lamp was almost ideal for street railway service. It only remained to prove the ability of this lamp to stand up under railway operating conditions.

There have been four mazda lamps standardized for regular street railway service, as shown in the following table. The 23-watt lamp was primarily designed for the replacement, lamp for lamp, of 64 and 42 watt carbon lamps. When replacing the former, it gives a slight increase in candle-power at normal voltage, but a steady candle-power over a wide range of voltage, thereby giving sufficient illumination at under-voltage where the illumination by the carbon lamp is not sufficient under these conditions. The 23-watt lamp also effects a considerable saving in current, amounting in some cases to one kilowatt per car.

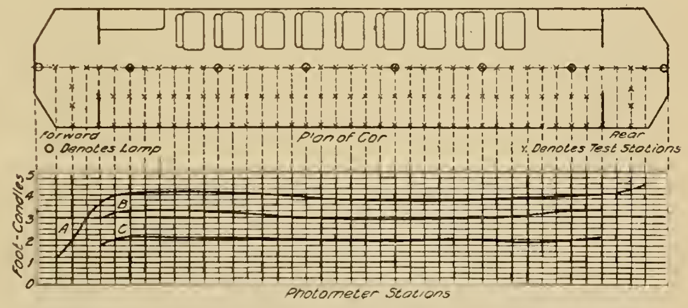
Description	Voltage groups	Nominal watts	Efficiency w.p.c.	Diam. bulb in in.	Overall length in in.
	105	23	1.34	2⅜	5¼
Straight	to	36	1.34	2⅜	5¼
side	130	56	1.20	2⅝	5½
		94	1.20	3 1/16	7⅛

The 36-watt lamp is designed for deplacing, lamp for lamp, the 64-watt carbon lamp, and, while affording a decided increase in the illumination of the car, still effects considerable saving in current. The 56-watt mazda lamp is intended primarily for use with Holophane reflectors, using only two circuits of lamps. The 94-watt lamp was also designed for use with reflectors, and is generally used in single circuits.

Construction

Improvements in the method of drawing tungsten wire have, of course, resulted in improved strength of the lamp; this, together with improvements in the methods of mounting, has made the mazda lamp satisfactory for practically any street railway service.

Another decided advantage of the drawn wire mazda lamp is the ability of the manufacturer to draw this wire to exact diameters, which means that in series operation all lamps in series are operating at the same efficiency and that manufacturers can supply lamps for an exact amperage. This enables street railway companies to obtain lamps at any time which will operate satisfactorily in series with those already installed, and to secure uniform brilliance of every lamp in the car.



Distribution curves for 34 ft. car equipped with 56 watt railway mazda lamps and clear reflectors. A, along centre line of car body 3 ft. above the floor. B, half way between the centre line of the car windows 3 ft. above the floor. C, along window sills.

In the manufacture of these lamps it is the present practice to use one size of wire for each size of lamp, regardless of the voltage; that is, the filament diameter is selected for lamps of a certain wattage rating at 115 volts and the filaments are cut longer or shorter, depending upon the voltage desired. This means that the wattage of the lamp would be slightly higher for higher voltage, and slightly lower for lower voltage; but this variation is not objectionable.

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* Harrison Works, General Electric Company.

Street railway mazda lamps are operated at somewhat poorer efficiency than lamps for regular multiple service, due chiefly to the fact that the cost of current is low and fairly long lives are justified.

An interesting point in connection with the operation of mazda lamps is that, when a failure occurs due to breakage of the filament, these lamps often re-weld themselves due to the vibration of the car. Although when this occurs it slightly changes the total resistance of the circuit, the efficiency at which these lamps are rated takes care of the slight increase in current which might result.

Systems

Practically all street railway cars found in operation a year or so ago were operating bare lamps, no attempt being made to re-distribute the light or prevent the glare of the filaments. Distribution was obtained by distributing a great number of small units rather than by re-directing the light from a few larger ones. Companies wishing to take immediate advantage of the characteristics of mazda lamps have replaced their carbon lamps, lamp for lamp, with mazda lamps. Of course, this represents a much smaller initial investment and presents an opportunity to immediately test out the new lamp. A better practice, of course, would be to re-wire the cars, using a smaller number of units with proper reflectors. A wiring diagram of a re-equipped car is shown, together with tests of illumination at different stations throughout the car.

It is seen that this illumination, while not only considerably higher than that of carbon lamps originally installed, is very uniform throughout. In this system, alternate lamps only are in the same circuit, so that the failure of one circuit still leaves better illumination than that given by the carbon lamps.

There are a great many varieties of circuits installed in present equipments, such as the joining of two circuits of four lamps each through the headlight, which requires the latter to be double the wattage of the lamps in the interior of the car. Some systems also have lamps of half the wattage in the sign boxes and markers. There is no reason, however, why all these systems cannot be equipped with mazda lamps.

Plans are being prepared for extensions to the London & Lake Erie Railway and Transportation Companies lines, work on which it is said will be begun in the spring.

Toronto Municipal Car Barns

The city of Toronto recently purchased a block of land at the corner of Bracondale and Benson Avenues for car barns, repair shops, etc., and are at present erecting, on one corner of this block, barns having an area of 198 ft. x 40 ft., a brief description of which is given herewith. The barns are divided into 11 bays, 18 ft. x 37 ft. 6 in. (inside clearance), and are constructed of steel framework on cement foundations. The design of the walls is shown in one of the accompanying sketches.

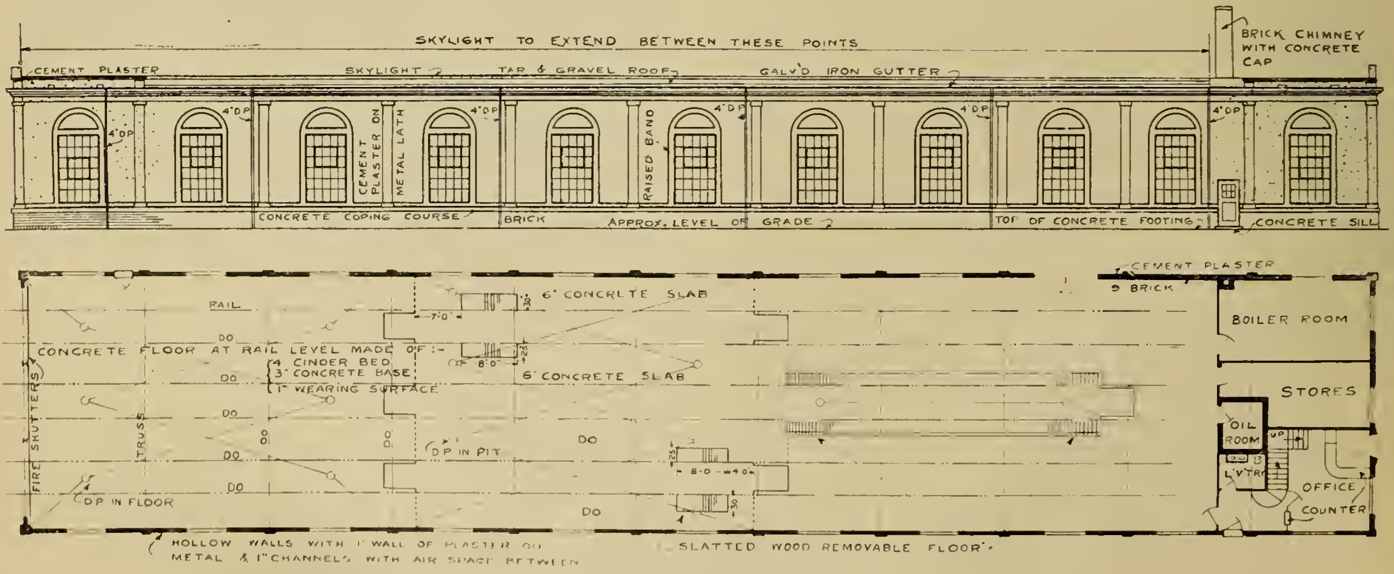
The plan and elevation of the new barns are also shown. The barns are so constructed as to be capable of extension at a minimum cost by addition of more sections. The building at present being constructed will accommodate nine cars.

An inspection pit occupies three 18 ft. bays near the centre of the building, the floor level of the pit being depressed 4 ft. 9 in. below the level of the main floor. This pit covers the whole area of 40 ft. wide by 54 ft. long as shown in the plan, and is not partitioned in any way, the superstructure being upheld by heavy I-beams placed vertically. Between the car tracks the space above the inspection pit is floored with cement slabs resting on the I-beam frame-work. At two convenient points, as shown in the plan, openings are left in this flooring to admit of a workman standing upright and inspecting the side of the running gear of the cars. When not so required these openings are covered with removable sections of wooden flooring.

A repair pit underlies the middle track at the extreme west end of the barns. This is the same depth as the inspection pit, but provision is also made at each side of the car for a convenient inspection of the wheels and other gearing; as shown in the plan an excavation has been made 2 ft. 3 in. wide and 2 ft. deep so that a workman may stand on this ledge and be at a convenient height to inspect the wheels or other equipment which is most conveniently reached from the side of the car. When these side ledges are not in use they are covered over by removable wooden slats resting on the cement on the one side and on the iron rail on the other side.

The floors throughout the barns are of concrete with the exception of the two areas at the side of the repair pit which are covered with maple flooring. A slight grade has been given the floors of the pits to points which connect with drains so that the pits may be kept dry at all times.

The first three bays at the entrance end of the barns will be used also as a washroom for the cars. The floor here is



Elevation and plan of Toronto's new municipal car barns, St. Clair Ave.

also graded slightly so as to obtain proper drainage, as shown in the plan.

At the extreme west end of the barns a section some 25 feet in length has been taken off for offices, stores, etc. It will be seen that the boiler room is loacted in this section, also oil rooms and washrooms. A conductor and motorman's room measuring 25 ft. x 18 ft. occupies, with a store room and the upper part of the boiler room, the second storey of the office compartment.

The roof is tar and gravel covered with a sky-light extending the full length of the building (roof truss figured for concrete slab later). Heating will be by forced air system, the pipes being all run underground. The hot air will be discharged at regular intervals along each side of the building from openings in the floor.

Municipalities Eager For Radials

Prior to his departure for England Hon. Adam Beck was the guest at a banquet in Guelph where some 300 delegates were assembled to discuss the question of an electric radial line connecting Hespeler with Guelph with some point on the Georgian Bay. The exact location of the line has not yet been decided upon, but the commission has been asked to make an investigation and report both on the most suitable route and on the cost of the road.

Great enthusiasm prevailed throughout, the scheme being endorsed by practically every delegate present. The 25 municipalities represented agreed to form themselves into a union to be known as the "Hydro-electric Radial Union of Western Ontario" with the purpose of assisting the commission in any move they may make towards the construction and operation of radial lines in Ontario. The officers elected for this union were as follows:—Hon. Adam Beck, honorary president; J. W. Lyon, president Guelph Radial Railway Company, president; G. B. Ryan, second vice-president; T. J. Hannigan, third vice-president; G. Powell, Hamilton, secretary-treasurer. Vice-presidents were added from twelve districts as follows: H. W. Ironsides, Puslinch; Geo. Forbes, Hespeler; Jos. Rooch, Arthur; A. A. Armstrong, Fergus; W. S. Middlebro, M.P., Owen Sound; John Bernie, K.C., Collingwood; Mr. Richardson, Flesherton; S. Bell, Dundalk; Geo. T. Thorp, president of Guelph Board of Trade; Alex Simmers, vice president Guelph Board of Trade; R. J. Ball, Hanover; L. U. Richardson, M.P.P., Elora.

The following resolution was passed unanimously:—"That this meeting, representing some 25 municipalities of the counties of Wellington, Grey and Simcoe and extending from the village of Hespeler through the city of Guelph to various points on the Georgian Bay, which municipalities are vitally interested in an electric railway system through this district and having regard to the great and satisfactory work of the Hydro-electric Commission in the Province of Ontario, realizes that no organization in the Province is better equipped or has better facilities for carrying out such a project. These municipalities, therefore, having long felt the need of reasonable transportation through this district and now realizing that through the passing of the Hydro-electric act of 1913 their great opportunity of securing said electric railway facilities is in sight, and further believing that their interest will be best served by an electric line built and operated by the Hydro-electric Commission, do here and now urge upon the Hon. Adam Beck and his colleagues of said commission that they give these municipalities their kindly assistance in compiling all the necessary information as to cost of construction and operation, method of financing and most suitable location of said line, so that it may serve the best interests of the people of the district. And in return they guarantee them their earnest co-operation and support in the building up of such a Hydro-electric radial system as shall bring the greatest development, progress and prosperity of the whole Province of Ontario."

The Middlesex county council have also indicated their eagerness to co-operate with the Ontario Hydro-electric Power Commission in the construction of radials in their county and the commission will be asked to prepare estimates on three different lines. One of these would connect Stratford with London and the other two would connect Chatham with Grand Bend by different routes, one by way of Lucan, and the other by way of London, Ailsa Craig and Parkhill.

Making a Good Start

The Tillsonburg Electric Car Company, Limited, have just received an order for two interurban cars for the Windsor, Essex & Lake Shore Railway Company to be built according to the following specifications:—seating capacity, 62; length over body, 44 ft.; length over bumpers, 55 ft.; width over all, 9 ft. 1½ in.; interior trim, polished bronze; roof, monitor deck style; bottom frame, composite wood and steel; interior finish, oak; heaters, Peter Smith; couplers, radial.

The same company have recently shipped two cars to the Dominion Power & Transmission Company, Hamilton, Ont., as described hereunder:—length over all, 51 ft.; length over body, 49 ft.; width over all, 9 ft.; interior trim, polished bronze; roof, monitor deck style; bottom frame, composite wood and steel; interior finish, chestnut; couplers, M.C.B.; trucks, Taylor extra heavy with rolled steel wheels.

A public meeting was recently held in Aylmer of representatives of the municipalities interested in the proposed extensions to the London & Lake Erie Railway & Transportation Company's system. It was decided that the different municipalities confer as to the proportion each should pay in guaranteeing the company's bonds. It is said the company will require a guarantee of $20,000 a mile and free right of way, but that under these conditions they are prepared to go ahead with the extensions at once.

General Manager Coleman, of the Hamilton Street Railway Company, is reported to have stated that his company is prepared to lay new tracks on King street from Catharine to Bay streets; on York street, from James to Queen streets; on Margaret street, from King to Main streets; and on Main street, from Margaret to Locke streets, and that the work will probably be commenced early next spring.

The March of Progress

The American consul at Jerusalem advises that companies desiring to compete for the adjudication of a tramway to be constructed at Jerusulam, and for the establishment of an electric-light system for the same city, in accordance with conditions which have been distributed, will have to present their bids to the Commission of Adjudication, which will be constituted at the Conak of the Government at Jerusulam. The concession will be granted for forty years.

New Books

Electric Arc Phenomena—By Ewald Rasch and translated from the German by K. Tornberg; D. Van Nostrand & Co., publishers; price $2,00 net. This book is a general review, with illustrations, covering both the theory and application of electric arcs. Its scope will be fairly understood from the following chapter headings:—(1) General Outline of Electric-arc Phenomena. (2) The Typical Carbon Arc. External Phenomena Arc Adjustment. (3) Typical Electrode Materials and Their Physical Properties. (4) The Theory of Electrical Discharges Through Gases. (5) Spark Discharges. Empirical Results. (6) Voltage and Current Conditions in the Arc. (7) Distribution of the Energy in the Arc. (8) Efficiency of Commercial Types of Arc.

The Dealer and Contractor

Electrical Equipment in a Calgary Store

The new store recently opened by the Hudson's Bay Company in Calgary and which is understood to be the first of a group to be established at different points in Canada is equipped with the most modern appliances as to heating, ventilation, refrigeration, illumination, etc. The new store is situated at the southwest corner of Seventh Avenue and First Street West, having a frontage of 250 feet on Seventh Ave. and 130 feet on First Street. The building at present consists of six storeys, but provision has been made for increasing to ten as the development of the business demands it.

The Generating Equipment

The electrical equipment at the present time consists of three 300 kw., 3-wire, d.c. generators, direct connected to a Corliss type 480 h.p. steam engine and it is the intention to install a similar unit for use at off peak hours, with possibly a storage battery. The generators produce current at 230 volts for power apparatus and 115 volts for lighting. The generators were supplied by the Canadian Westinghouse Company and the engines by the International Engineering Works, Amherst, N.S., the boilers were built by Babcock & Wilcox.

The Switchboard

The main switchboard is very completely equipped with instruments. Its dimensions are 27 ft. x 8 ft. 4 inches, blue Vermont marble. Each generator is equipped with two ammeters, a double-pole interlocking circuit-breaker, two double-pole and a single-pole fused switches, a field rheostat and a voltmeter receptacle. On the totalizing panel are mounted an ammeter for registering the total output of the generators equipped with shunts so that it may be used to calibrate the wattmeters; two Thompson astatic type integrating wattmeters, one to record the output for lighting service and the other the output for power service, ground detector lamps, a voltmeter switch, an ammeter switch and a clock connected to the store clock system. The feeder panels are equipped with triple-pole switches for lighting and double-pole switches for power feeders. All fuses are mounted on slate slabs at the rear of the board and every switch and every fuse slab is provided with a copper name plate to identify it. At the left end of the board is a bracket carrying two indicating voltmeters, one reading 0-300 volts, the other 300-0-300 volts. The arrangement of voltmeter plugs and switches is such that the bus-bar voltage and the voltage of the incoming machine may be read simultaneously when paralleling generators. The switchboard was supplied by the Canadian Westinghouse Company.

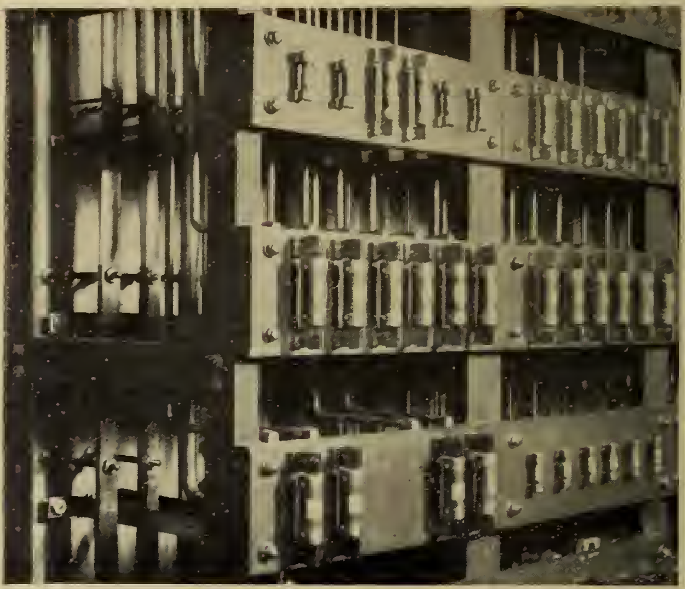
The Illumination

The main floor is lighted by Canadian General Electric triple carbon arc lamps which are mounted in handsome spun brass castings. The globes are of Alba glass. The lamps are suspended from the ceiling by an ornamental brass chain at a distance of 10 ft. 6 in. from the floor. The light is said to be especially suitable for matching fabrics in addition to providing an attractive and pleasing effect. Semi-indirect units are used on the upper floors consisting of 14-inch bowls of Moonstone glass with a highly polished inner surface and a Doric ridged outer surface. These bowls are hung by triple chains and each carries a single 250 watt tungsten. There are two fixtures in each bay of 396 feet area.

The show windows are equipped with Holophane steel reflectors of the poke-bonnet type, each carrying 60 watt tungstens. The fixtures were all manufactured by McDonald & Willson, of Toronto.

Telephones, etc.

A complete telephone installation connected to the Calgary municipal system has been provided. Also an electrically operated system of clocks controlled by a master clock of the mercury compensating pendulum type. A watchman's time detector system has been installed to guard against fire and theft; stations are placed at three points on each floor at each of which the watchmen must register; a battery is used to operate the system. A Gamewell signal system has also been installed. A pneumatic tube for carrying messages and cash to the central point is operated by motor-driven blowers. The refrigeration system is also motor-driven, as is also the ventilation and heating, the latter of which is partly by the indirect method of blowing air over heated coils and partly by the direct method of steam radiators.



Small section of rear of Switchboard.

Motor Equipment

One gets a fair idea of the value of the electric motor in a public building of this sort by the following complete list which gives the size of each motor and the use to which it is put.

4 35 h.p. for passenger elevator machines.
1 35-h.p. for employes' elevator machine.
2 35-h.p. for freight elevator machines.
2 7½-h.p. for main blowers, vent. rooms Nos. 2 and 3.
1 5-h.p. for main blowers vent. room No. 1.
3 7½-h.p. for vestibule blowers, vent. rooms Nos. 1, 2 and 3.
3 2½-h.p. for air washer pumps, vent. rooms Nos. 1, 2 and 3.
1 12-h.p. for exhaust fan for main floor.
1 12-h.p. for exhaust fan for boiler and pump rooms.
2 2½-h.p. for exhaust fan for shipping room.
1 5-h.p. for exhaust fan for engine room.
1 3-h.p. for exhaust fan for toilet rooms, 3rd and 4th floors.
5 ¼-h.p. for exhaust fan for small toilet rooms.
1 5-h.p. for exhaust fan for kitchen.
1 5-h.p. for exhaust fan for restaurant and cafeteria.
1 ¼-h.p. for exhaust fan for bakeroom.
1 10-h.p. for vacuum cleaner machine.
1 15-h.p. for house pump.
1 7½-h.p. for well pump.
1 7½-h.p. for brine pump.
1 3-h.p. for drinking water pump.
1 20-h.p. for large sump pump.
1 3-h.p. for small sump pump.
2 7½-h.p. for cash blowers.
1 1¼-h.p. for parcel belt conveyor.
2 ½-h.p for motor generator sets.

The Electric Wiring

Perhaps the most interesting feature of the electrical installation from the contractor's point of view is the wiring and switching arrangement and the following complete description will be of interest.

From the switches on the feeder panels of the main switchboard in the engine room the feeders are taken up into a large sheet-iron junction box, which is mounted directly over the switchboard and extends its full length. This arrangement admits of changes being easily made in the feeder connections. From this junction box two-wire feeders for power are carried to the various fan rooms, elevator machine rooms and to the various electric motors in the engine and pump rooms.

Illumination of main floor.

The lighting on each of the upper floors is controlled from four panels located on the south side of the floor. These panels are built of black slate and provided with three-wire bus-bars with two-wire branch circuits, each controlled by a push-button switch.

An interesting feature of these panels is their arrangement with two sets of bus-bars. A limited number of lights is controlled from the smaller set of bus-bars, for use at night when the floors are being cleaned. Each of the four tiers of panels, from the second to the sixth floors, inclusive, is controlled by two sets of feeders, one for the night bus-bars and one for the day bus-bars, so that at night time the unnecessary waste of energy for light may be prevented by the opening of the switches controlling the "day feeders" at the switchboard. During business hours both night and day circuits are in use. The lighting of the main floor is controlled by four panels similarly arranged with double sets of bus-bars and each provided with separate feeders from the switchboard. A panel for controlling the lighting of the pent houses is located in one of the pent houses. An additional panel for controlling the roof standards, and provided with its own feeder direct from the switchboard, is located in a pent house. A panel for controlling the lights in the shipping room and one for controlling the lights in the boiler, engine and pump rooms are located in the basement. Here is also located a separate panel for controlling all the lights in the stair halls, in front of the passenger elevators, in the freight vestibules and in the elevator cars. The lights at these points are connected in vertical rows so as to insure, as far as possible, light at these points even if one circuit is temporarily out of commission.

The lighting of the show windows and marquises is controlled from five special panels located on the main floor and directly controlled from the switchboard. These panels are arranged with three sets of bus-bars. Two of these feed alternate lights in the show windows and one the receptacles in these windows. In the show window panels near the entrance two additional sets of bus-bars are provided to supply the lights in the marquises. One of these panels is provided for each group of show windows. Each set of bus-bars is controlled by a three-pole knife switch. The branch circuits have enclosed fuses, but no switches. In addition to the ceiling outlets for lighting fixtures, base receptacles have been installed at all columns, and, on the first, second and third floors, floor receptacles for the purpose of illuminating the display cases and counters. Each fixture is provided with a push-button switch, placed in a pocket in the fixture.

For supply power for sewing machines, electric irons and other purposes in the work rooms two sets of feeders are installed, one at the east end of the building and one at the west end. The panels in the work rooms are arranged with three-wire bus-bars and provided with one 25-ampere switch for power at 230 volts, two for irons at 115 volts and four for lighting over the work tables at 115 volts.

L. K. Comstock and Company were the general contractors for the complete electrical and mechanical equipment the contract including furnishing and installing boilers, power piping, heating, engines, generators, switchboard, complete wiring for lighting, power and low tension work, sprinkler system, plumbing, pneumatic cash tube system, refrigeration, etc.

Collecting Accounts

From the honeyed letter to the blunt sheriff's officer there are many ways of trying to collect accounts and Mr. Burt gives some good suggestions in the current issue of the National Electrical Contractor. Mr. Burt strongly advises that no stereotyped letter can be made to fit all cases. He is also a believer in following up accounts promptly, preferably by personal calls, but if this is not possible then by pointed letters. The article, in part, follows:—

"The writer has been engaged in collecting commercial accounts for several years, but has never yet found an iron-ribbed letter that would always bring results—or even an answer. If I could find such a writing, my future would be a life of luxury and fortune. However, I do not condemn these books or their forms.

My experience in the collection business has taught me that even the best of letters, whether copied or original or both, should not be used if a personal interview with the debtor is possible. My experience has taught me other things, too, and I give below a short set of rules which seem to me most important to be observed when making collections:

First. The early bird catches the money worm. When your account is due, collect it.

Second. Never write a collection letter when it is convenient to make personal solicitation. It is easier to throw a typewritten sheet into the paper basket than one's creditor into the street. If you cannot go yourself, send a clerk. And if at first you don't succeed, stick around. Creditors are embarrassing, and persistence wins.

Third. If you must of necessity write a collection letter, write it to the point. Do not hesitate to state the purpose of the letter directly and firmly, but politely.

Fourth. Do not write excuses in your collection letters. If the account is due, you have a right to collect it. An excuse for your wanting it gives the debtor an opportunity for an excuse for not paying it. If you write that you have obligations to meet and therefore must have your money, he will reply that he likewise has obligations and he must have your money.

Fifth. After you write a collection letter, be honest with your debtor and do exactly as that letter says you will. If your letter says you will sue, sue. A business man comes to be known by his threats to his debtors. If you want their respect, keep your threats. This means being honest with your debtor—and yourself.

As I stated before, there is no one letter that will serve every collection purpose. There is no one letter that will have the effect upon every debtor-recipient's mind that you wish it to have. I suggest below three forms of letters for ordinary commercial accounts, to be altered for each different collection so as to present the correct facts. I do not offer them only as a panacea for collection ills. I offer them only as a basis upon which other letters may be built and perhaps successfully used.

When an account is overdue it might be called to the debtor's attention in this way:

Joe Doe,
99 Hoe Street, Moeville, Pa.

Dear Mr. Doe:

You have doubtless overlooked the payment of your October account. Kindly favor me with a prompt remittance of the amount due—$99.00.

Very truly yours,

Ten days after letter No. 1 goes forth, you might try this one, providing no payment had been made in the meantime:

Dear Mr. Doe:

Ten days ago I called your attention to the fact that your October account had not been paid, and asked you for a prompt remittance. No response to that request has been received by me. This account is now considerably overdue. Please forward payment thereof immediately.

Very truly yours,

In case Mr. Doe continues obstinate I should suggest this:

Dear Mr. Doe:

Please let me have payment of your October account before December first. Unless it is paid before that date I shall hand it to my attorney for collection.

Very truly yours,

And I should sue."

Conduit Work in a Fireproof Building

One of the most difficult problems encountered in designing the electrical work in buildings of certain classes is that of selecting the best locations for the ceiling outlets. And after the best that is possible along this line has been done it is often necessary, when the building is ready for occupancy, to add new outlets or to change the locations of some of those already installed. Moreover, such revisions of the wiring are quite liable to be troublesome to make in a manner that is satisfactory. To take a specific example, consider the modern type of fireproof office building. The requirements of the tenants on any floor of such a building can hardly ever be fully anticipated while the wiring is being done; the work can only be laid out to meet their probable needs, and then when the arrangement of the offices is definitely known, important changes in the location of the ceiling outlets may be found to be desirable. Thus, at best, it becomes necessary to do more or less of objectionable cutting and patching in the ceiling. This process is expensive, and if the work is not done by skilled workmen the ceiling structure may even be materially weakened.

Having realized the foregoing difficulties, from experience in the construction field, a firm of electrical contractors in Chicago developed a new and very interesting system of concealed conduit construction, not long ago, the principal object of which is to provide new lighting outlets in a building without the necessity of resorting to any objectionable cutting of ceilings and floors and the consequent patching of the plaster. The first installation of this kind is now being completed in one of the large fireproof office buildings in Chicago.

Characteristic features of the construction under consideration consist in the fact that the conduits for the accommodation of the ceiling outlets are placed in the ceiling just above the plaster, and that, by means of a tool designed for the purpose, an outlet can be readily installed at any point in a run of conduit after the ceiling is finished, without the necessity of cutting a hole in the plaster larger than can be covered with a fixture canopy of the usual size. In fact, ceiling-outlet boxes will not be installed on any part of the job until the space on the various floors is rented and the tenants specify where the outlets are wanted.

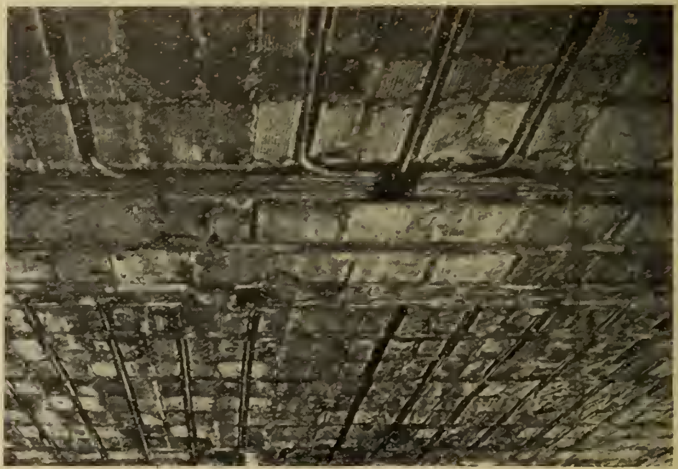


Fig. 1.—Showing portion of ceiling before plastering.

The Webster Building, in which the system is being installed, is a 12-story-and-basement fireproof structure with tile floor arches. The National Fire Proofing Company made a special grooved tile block and soffit tile for this building, the cost of which, it is claimed, was no greater than that of standard tile. In one or two instances when the tile setters ran out of the ordinary tile, the conduit was spaced to set in the seam between the arches, which demonstrated that this method is also practical, though not so desirable as the special tile.

The conduit was installed 13 inches center to center, almost throughout the ceilings (which is the maximum Universal layout), and was laid on the centering, or temporary planking, used by the fireproofing. The conduit hangers, which hook around the pipe and clamp to the flanges of the I-beam, were then set in place and locked up tight, securely holding the conduits in their exact positions. One end of each conduit run was closed with a gas cap, and the other end terminated in a small junction box. With only two exceptions on each floor, each junction box was the terminal for one end of each run in two adjoining offices. These boxes are approximately 6 by 8 inches, and are provided with a plaster cover with a 4-inch round opening in the center. This is all concealed, as are the conduits, by the plaster. A round flat cover is provided for the opening in the plaster cover, which is drilled for screws and countersunk so that when installed it protrudes only the thickness of the metal below the finished ceiling. When painted over this cover is not noticeable, though as a hand-hole it allows access to the wires and connections from all conduits terminating therein.

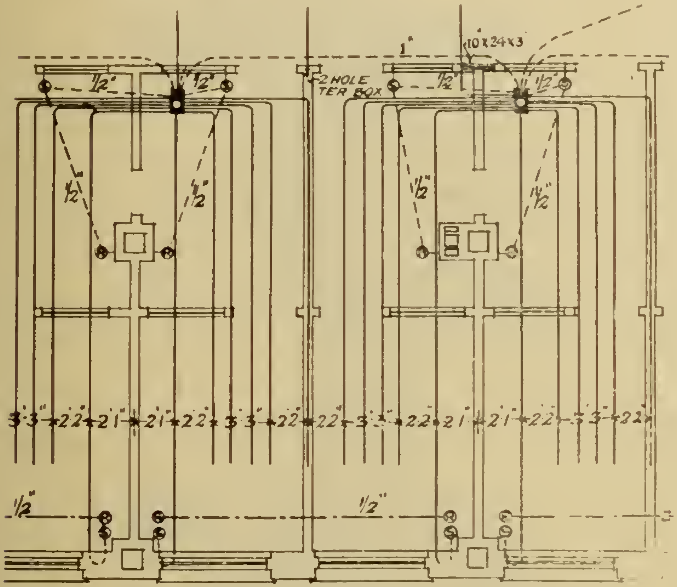


Fig. 2.—Plan of conduit construction.

These boxes and conduits are flush with the bottom of the tile and are concealed only by the plaster. The homeruns from the junction boxes to the panel cabinet are one-inch conduits over the top of the tile, as is present practice. For greater flexibility all junction boxes are interconnected with one-inch conduits; an idea of this flexibility may be obtained from the fact that a switch in the northeast corner of the floor can be connected to a fixture in the southwest corner without touching the plaster. The junction boxes replaced troughs which it was originally intended to use.

Switches and receptacles are being installed in columns and outside walls only, where they cannot be covered by future partitions.

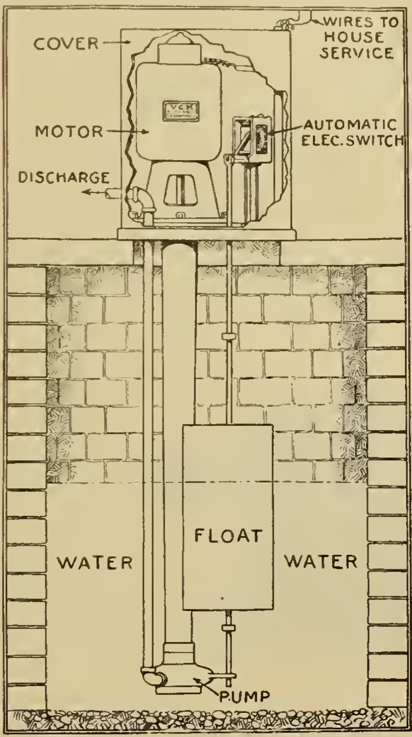
A valuable feature made possible by this system as installed in this building is that all receptacle outlets to outside walls are connected with half-inch conduit. This allows the installing of a receptacle anywhere on this pipe at any time during the life of the building. All switch legs terminate in the junction boxes, and at this point may be connected to any or all conduits in the room.

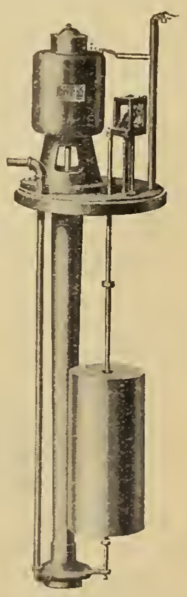
Fig. 1 shows portions of the ceiling before the plastering was done. The method of running the conduits from the junction boxes is brought out very clearly. Fig. 2 is a working drawing of the conduit construction in a portion of the ceiling. Dotted lines show how the junction boxes are interconnected, while the dotted line extending to the right from the junction box in the upper right-hand corner of the figure indicates the circuit from the wire shaft containing the risers from the service board in the basement.

Outlets will be provided by milling out the lower half of the conduit with a special milling machine and fastening a conduit-outlet box to the pipe with U-bolts, the box and bolts being of special design. It is claimed that the conduit can be milled out without disturbing the conductors and that no rough edge or burr will be left at the opening to injure the insulation.—Electrical Review.

Automatic Electric Cellar Drainer

Those who are troubled with wet cellars or basements will appreciate the value of the automatic electric cellar drainer illustrated herewith. This device, it is claimed, is the first practical drainer of moderate price suitable for private residences, apartments, elevator pits, etc. As shown by the diagram it consists of a centrifugal pump direct connected to a vertical Westinghouse motor. The pump is installed in a three-foot well into which the seepage drains, the motor and control apparatus being at the floor level where it is accessible for inspection and is out of the way of dampness. A float plays between between two stops on a vertical rod that is connected with the motor control switch. When the water in the well rises sufficiently to cause the float to press against the upper stop, the motor is started and continues in operation until the water level is lowered so that the float presses against the lower stop, when the current is cut off. The seepage is thus cut off without attention, an occasional inspection and lubrication being all that is required. This pump has a capacity of 500 gallons per hour against a head of 5 feet, and 150 gallons per hour against a head of 20 feet. To install it all that is necessary is to provide a well three feet deep, place the pump, and make the electrical connections. It operates from the electric lighting circuit. The Vaile-Kimes Company, Dayton, O., manufactures the outfit.





Motor-driven pump for draining purposes.

A Prosperous Business

The firm of John Starr Son & Company have just moved into their new fine building on Grenville Street, Halifax, N.S. This is a handsome four-storey stone building 23 ft. x 66 ft. with basement, finished in hardwood and fitted with modern offices, showrooms and storage facilities.

It is interesting to note that this firm represents the oldest electrical supply house in Canada. As far back as 1880 Mr. Starr established the business in a small way, from an electrical point of view, as may be understood when we remember that at that time the incandescent electric lamp was unknown and the electric motor had not come into commercial use. In the mean time the firm has grown with the electrical business and recently they have had in charge some of the largest electrical installations in the East. At the present time this firm is installing the complete electrical equipment of the Woodside Sugar Refinery, Halifax, where in addition to other electrical requirements there will be nearly 200 motors installed, every machine in the refinery being electrically driven.

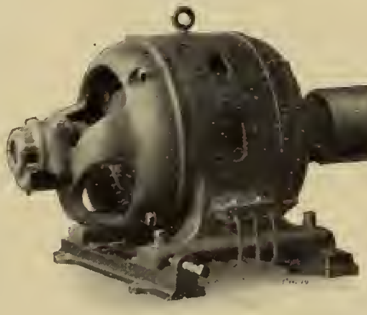
Some four years ago the founder of the firm, Mr. John Starr, died and was succeeded by Mr. Chas. C. Starr as president and managing director. Mr. J. H. Lockhart is engineer and sales manager of the company and Mr. J. T. Dorey secretary-treasurer.

A Self-Starting Polyphase Motor

The Wagner Electric Manufacturing Company of St. Louis, Mo., have placed on the market a polyphase motor that is self-starting under full load by merely closing the service switch. As the current taken at the instant of starting is not more than that taken by the usual polyphase motor with a starting box, there is no objection to its use in sizes up to 50 h.p. on central station lines.

The stator or field of this motor has the usual polyphase winding. The rotor, or armature, is exactly similar to the rotor of the single-phase motor originated by this company. At starting, the coils are connected in a series parallel arrangement giving the motor high resistance rotor characteristics. When about three-quarter speed has been attained all coils are short-circuited by a centrifugal mechanism, after which the rotor operates as a squirrel cage induction motor.

This motor is particularly adapted to remote control service and can be located at a considerable distance from the control switch. If the service should fail the motor will stop with connections made for automatically starting. It is not necessary for an attendant to make a trip a quarter or a half-mile to start the motor when service is restored. For automatic control by float switch, pressure switch, etc., this motor can be used to excellent advantage, saving the expense of complicated and expensive starting switches that are usually necessary when ordinary types of polyphase motors are used. A twenty-five horse-power motor of this type is shown in the illustration.

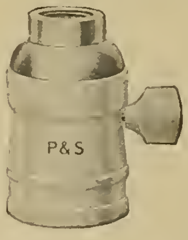


New Electric Water Heater

A 660-watt electric water heater of new design has been added to the line of water heaters made by the Cutler-Hammer Manufacturing Company. This new heater, illustrated herewith, has a water capacity of three quarts and because of its low consumption of current it can be attached to almost any lighting circuit. For the purpose of guarding against waste of current a small pilot lamp is mounted in the base of the heater, under a ruby glass lens, this serving as a signal light to show when the current is on, and as a reminder to switch it off when the heater is no longer required. A flush switch is mounted in the base, the two buttons of which facilitate the operation of switching on and off the current. These heaters are of special value in the cooler months in buffets, restaurants and drug stores where they can be used in dispensing hot drinks at the counter or for furnishing hot water for any purpose. In the home they are suitable for furnishing hot water almost instantly for tea, coffee, cocoa or other hot drinks, soups, broths, for the shaving mug or for any other purpose for which hot water in small quantities is wanted quickly. The frosted glass globe is decorated with cut glass stars and the base is heavily nickel plated. The heating unit is a new type and can be readily renewed.

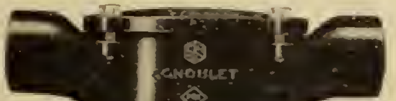
A New Lamp Socket

The accompanying illustration represents the latest addition made by Pass & Seymour to their interchangeable porcelain sockets. These interchangeable sockets are claimed to be growing in popularity on account of the fact that in the event of a ground on the line the user is protected by a porcelain shell. This new unit is supplied complete as shown with a one-half inch aluminium cap.



Water-Tight Condulets

The accompanying illustration is representative of the type PR series of condulet, manufactured by the Crouse-Hinds Company of Canada, which are for use where durable water-tight junction boxes of medium size are required, as in railroad yards and shops. They are also suitable for underneath or overhead car wiring installations. The hubs on these condulets are so designed as to insure a clearance of at least three-quarters of an inch between the surfaces wired over and the conduit. These condulets, where used on car roofs, give no opportunity for the accumulation of cinders—a feature which prevents the otherwise rapid deterioration of the roof covering along the conduit and around the condulet. The cover overhangs the condulet body and is held in place by four heavy brass cap screws. The joint is made water-tight by a gasket. The bottom of the condulet is reinforced at the centre, to allow drilling and tapping for an extra conduit or for the suspension of a centre lamp fixture of pedestal design.



Midas Mystery Platform

The Midas Mystery Platform is one of the latest display window advertising novelties. It consists of an ebony case, the top of which is formed by a mirror. On this mirror rests a velvet pad or "platform," which carries the article to be advertised. The "platform" moves about on top of the mirror in a most mysterious fashion, there being apparently no means whereby this motion could be caused as every part of the unbroken mirror surface can be seen at one time or another. In this way the observer's attention is drawn directly to the article being advertised. How is it done? Frankly we don't know as the manufacturer won't tell us. The only hint he drops is that a 1/20 h.p. Westinghouse motor is at the bottom of the mystery. This device is made by the Mercantile Advertising Company, New York.

An electric railway line connecting Battleford with North Battleford is being promoted. It is probable that a by-law will be submitted in the near future.

Insulating Type Couplings

The cuts herewith represent something new in electric hardware. These insulating type couplings, known to the fixture trade as insulation joints, were originally made of cast iron or brass and later of malleable iron. A type of joint is now being produced in which drawn steel is used exclusively. Fig. 1 represents a drawn steel shell inwardly flanged and corrugated to give a grip on pipe tongs or wrench. Fig. 2 shows a drawn steel thimble consisting of a threaded cap with a "pie crust" fluted flange. This joint complies with the underwriters' requirements that insulating joints used on electric and combination fixtures should have double insulation and should stand a test at either end of 4,000 volts, alternating current, for five minutes. The insulation is of the nature of artificial stone moulded in place and subsequently hardened and has been given the name Di-el-ite. This is a product of the Wirt Company, Philadelphia, who also manufacture the above special joint.

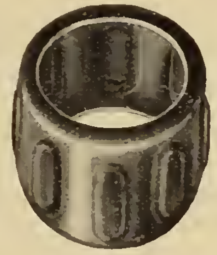


Fig. 1.

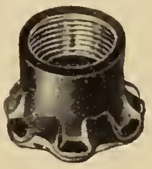


Fig. 2.

Portable Sub-station for a Coal Mine

The Berwind-White Coal Mining Company, Windber, Pa., have recently added a 400 kilowatt Westinghouse portable sub-station to their equipment and are making a very interesting use of it. The sub-station consists of apparatus for changing alternating current into direct current, and is generally necessary in mining work because direct current must be used for haulage in mines but cannot be transmitted economically over long distances. Hence, when the mine is located some distance away from the power station that serves it electric power can be transmitted more efficiently as alternating current at a high voltage and then transformed to direct current in the sub-station.

The Berwind-White Company are developing these outlying properties very rapidly and need direct current at points where permanent sub-stations are not yet erected. In order to prevent delays in the development the use of a portable sub-station was decided on. This sub-station has the same equipment that a permanent installation has; namely, transformers to step down to a moderate value the high voltage of the current received from the transmission line, a switchboard, and a rotary converter, which receives alternating current and delivers direct current. This apparatus is mounted in a car resembling an ordinary freight car.

When the work at a new development reaches the point where direct current is necessary the portable sub-station is hauled out to the workings, connected to the alternating current transmission system, and started to work generating direct current. When the permanent sub-station is built the portable one becomes unnecessary and is taken to the next development. A further use of this sub-station is to provide insurance against shut-downs. If accidents occur at any of the permanent sub-stations, the portable outfit is sent to carry the load until repairs are completed. One portable sub-station, therefore, is practically the equivalent of a duplicate set of apparatus at each permanent sub-station.

Current News and Notes

Birtle, Man.

A by-law was submitted on December 16 to authorize the expenditure of $3,000 on a telephone system.

Brantford, Ont.

It is expected that the street lighting system will be ready for operation by January 15 and that domestic and commercial lighting can be attended to by February 1.

Collingwood, Ont.

The Imperial Steel & Wire Company have awarded a contract to the Canadian Westinghouse Company for motors, transformers and other electrical equipment required in their new factory.

Camrose, B.C.

The town council have decided to supply free power for verandah lights as a satisfactory means of illuminating the streets.

Cote St. Paul, P.Q.

In order to secure a greater quantity of power, the Department of Railways and Canals are constructing a new power house at Cote St. Paul on the Lachine Canal, P.Q. At present there are two power houses on the canal; one will now be abandoned, and the new one built near the site of the second. The power is utilized for lighting the waterway and for opening and closing the dock gates. The new building will be 70 ft. x 70 ft., and the structure will be a one-storey one. New generating equipment will be installed, consisting of four turbine wheels 60 in. in diameter; one turbine wheel 36 in. in diameter, two exciter wheels five generators, and two transformers. The head of water is 8 ft. 6 in. The equipment will be capable of generating a total of 650 horse power.

Donnacona, P.Q.

The Quebec Government has sold its channel rights on the Jacques Cartier River to the Donnacona Paper Company for $1,000 on condition that the company spend $100,000 within four years for improving the hydraulic power.

The Ambursen Hydraulic Construction Company of Canada, Limited, Montreal, are suing the Donnacona Paper Company, P.Q., for some $100,000 in connection with a contract for building a dam for power purposes. It is claimed that the plaintiffs contracted to build the dam upon a percentage basis, and that the defendants stopped the work.

Edmonton, Alta.

The Macdonald Hotel in Edmonton to be built by the Grand Trunk Pacific Railway Company, will probably be supplied with light and power from its own generating plant.

A number of private companies are said to be preparing offers to supply electric power to the city at a lower rate than it can be supplied by the municipal plant. One of these at least proposes to develop power at a nearby coal mine and transmit the power at high tension to Edmonton. In the Wabamun district, 40 miles west of Edmonton, there is said to be 60,000,000 tons of lignite coal easily available and indeed it is pretty generally understood that the whole of Alberta is practically underlaid with lignite.

Fredericton, N.B.

The Eel River Light, Heat & Power Company, who have a site capable of developing some 4,000 h.p. of hydro-electric energy have made an offer to Fredericton to supply them with energy for light and power purposes on a meter basis of 2c per kw.h.

Fort William, Ont.

A by-law will be submitted on January 5 authorizing $125,000 expenditure on telephones and $115,000 on electric light and power extensions.

For the year ended 31st October last the earnings of the Kamistiquia Power Company were $302,741, an increase of $58,855. Operating expenses were only $8,414 higher, leaving a net revenue of $262,638 as against $212,197 last year. The balance evailable for dividends was $180,039, an increase of $50,843, or about 40 per cent. This is equivalent to 9 per cent. earned on the $2,000,000 stock. The surplus after charges and dividends amounted to $45,039, as compared with $14,796 for the previous year. This increase is shown despite the fact that dividends at the rate of 5 per cent. were paid during the year, an increase of 1 per cent. over 1912. Owing to the increased demand for hydro-electric power, the company will enlarge their plant by the installation of an additional 12,000 horse power unit. This should be ready for operation by next July. To meet the cost of this construction, an additional $200,000 of stock will be issued in the near future.

Galt, Ont.

The Galt, Preston & Hespeler Railway Company are installing transformers and a new rotary converter which will approximately double their present power capacity.

Gananoque, Ont.

The new lighting system of this town installed by the Gananoque Electric Light & Power Company, Mr. J. M. Campbell, superintendent, was recently placed in operation in one of the wards. It is expected that the service will be inaugurated in other sections of the town very shortly.

Goderich, Ont.

It is expected that hydro power will be in operation in this town by January 1.

Grand Falls, B.C.

Telephone connection between Grand Falls and the Western Pine Lumber Company's camp, 28 miles north of this city, has been established on the new line being built by the Forestry Department. The wire is strung about seven miles further and it is expected to be completed to Franklin camp in about a fortnight.

Hamilton, Ont.

The Fire Underwriters' Association have advised the duplication of the present pumping equipment in Hamilton.

The Bell Telephone Company moved into their new building on December 14. The cut-over was completed without causing any delay to the service.

The Toronto, Hamilton and Buffalo Railway Company have practically completed the installation of their automatic block signal system, electrically operated, between Hamilton and Welland.

Lacombe, Alta.

The municipality of the town of Lacombe will, in the near future, install an engine type 277 r.p.m., 100 kw., 3-

phase, 60 cycle, 2300 volt generator complete with field rheostats and pulley from which to belt an exciter. Mr. E. J. Tett is secretary-treasurer and commissioner.

Le Pas, Man.

The municipality of Le Pas are at present installing a 240 h.p. Diesel engine direct connected to a 200 kv.a. generator. The engine was supplied by the Boving Company of Canada, and the generator and exciter by the Canadian Westinghouse Company. The switchboard and switching equipment and the street lighting system are being supplied by the Canadian General Electric Company and the necessary transformers by the Canadian Moloney Electric Company. The plant is being installed by Murphy & Underwood, consulting engineers, Saskatoon, under the immediate supervision of Mr. R. A. McLellan as resident engineer.

A by-law was passed on Dec. 16 authorizing the issue of debentures to cover the cost of the electric plant which is being installed.

Montmorency Falls, Que.

The Dominion Textile Company are making considerable extensions to their plant here. The new extensions will be entirely driven by electricity.

Montreal, Que.

Tenders will be received up to December 30 by the Board of Commissioners for lighting fixtures for the city hall annex.

The Montreal Tramways Company have opened a new belt line in Westmount, joining the upper and lower levels of that city.

Mr. H. S. Holt, president of the Montreal Light, Heat and Power Company, is a patient in the Royal Victoria Hospital, suffering from scarlet fever.

The late Mr. James Ross, of Montreal, whose estate for $14,316,256 has been entered for probate, was a holder of 529 Canadian General Electric shares, 1,844 Electrical Development shares, 5,080 Brazilian Traction, Light and Power shares, and 2,000 Montreal Light, Heat and Power shares; he also owned bonds to the value of $138,750, in the Mexican Electric Light Company, and $49,500 in the Rio Janiero Light Company.

Morrisburg, Ont.

The corporation of the town of Morrisburg has entered action for the return to it of the power plant now being used by the Hydro-electric Power Commission of Ontario to supply power for distribution at certain points in eastern Ontario. This plant was originally owned and operated by the municipality but in April, 1912, was handed over to Mr. J. L. Sharkey who undertook to open a sheet steel factory and operate certain other industrial enterprises as well as supply the town with light. Mr. Sharkey failed to live up to his agreement and instead handed his plant over to the Hydro-electric Power Commission.

Nelson, B.C.

By-laws will be submitted at the January elections authorizing the raising of $30,000 to pay debts and provide for improvements on the street railway system.

Neepawa, Man.

Orders have been placed for the following apparatus for the town of Neepawa by their consulting engineers, W. E. Skinner, Limited: With the Goldie & McCulloch Company, of Galt, Ont., for two 72 x 18 return tubular boilers and one 12 x 19 x 8 vertical compound condensing engine operating at 450 r.p.m.; and with the Canadian General Electric Company for one ATB, 150 kv.a., 450 r.p.m., 2400 volt, 3-phase, 60 cycle, a.c. generator.

North Toronto, Ont.

Messrs. A. T. & W. J. Thompson will erect a two-storey planing mill and will operate the machinery by electric power.

Ottawa, Ont.

The directors of the Ottawa Light, Heat and Power Company are issuing $700,000 new capital stock for development work in connection with both their gas and electric subsidiaries.

Tenders are called by the Department of Works of the Dominion Government up to January 15 for 10 knots of gutta percha cable with four conductors and 14 knots of two conductor cable, to be delivered at Halifax May 1, 1914.

The new rates which go into effect January 1 are as follows: Domestic lighting 4c per 100 square feet plus 2½c per kw.h. with 20 per cent. reduction; commercial lighting, 6c per kw.h. for the first 30 hours use and 2½c per kw.h. for all additional with 20 per cent, discount; power, a service charge of $1.00 per month per h.p. of connected load or maximum demand plus a graded consumption from 1.8c per kw.h. down, depending on the quantity, the discount depending on the class to which the consumer belongs.

Peterboro, Ont.

At a recent meeting of the city council the franchise of the Otonabee Light & Power Company was cancelled. This will mean that after January 1, 1914, the customers of this company will not be supplied with light or power until such time as the hydro-electric system is installed.

Mr. A. B. Colville, vice-president of the Peterboro Light and Power Company has offered to continue to supply power and light to Peterboro at the old rate until such time the city can arrange to attend to this supply itself.

The new street lighting system, consisting of magnetite lamps, has been completed by the Hydro-electric Commission and power to operate them will be supplied temporarily, at least, by the Peterboro Light & Power Company .

Plessisville, Que.

The electric line connecting Plessisville with the Shawinigan Water & Power Company's lines has been completed and it is expected light and power will be available by the new year.

Port Arthur, Ont.

A by-law will be submitted on January 5 authorizing the expenditure of $8,000 in electric light extensions.

Preston, Ont.

A by-law will be submitted on January 15 authorizing the renewal of the franchise of the Galt, Preston & Hespeler Railway Company for 25 years with power to make certain extensions and improvements.

Quebec, Que.

The Merchants Light, Heat & Power Company have submitted to the local legislature a by-law to amend their charter by increasing their capital from $800,000 to $3,000,000.

Regina, Sask.

The Grand Trunk Pacific Hotel, the Qu'Appelle, to be erected in Regina, will be supplied with light and power from an isolated power plant which will also supply the railway station located near the hotel.

The operating returns of the municipal street railway system for the week ending December 6 were as follows:—revenue $4,423; passengers carried 105,007; passengers carried including transfers 119,746. Corresponding figures for week ending December 13 were:—$3,998.25, 96,460 and 110,296.

Richmond Hill, Ont.

A by-law will be submitted on January 5 authorizing the expenditure of $4,000 on electric light extensions.

Sault Ste. Marie, Ont.

A meeting of the International Joint Commission will be held in Washington beginning January 13, to consider the application of the Michigan Northern Power Company for authority to build a dam for power purposes at Sault Ste. Marie; also the application of the Greater Winnipeg Water District to divert water from Shoal Lake, west of the Lake of the Woods, for the purposes of a water supply for the city of Winnipeg.

Souris, Man.

The contract has been awarded to the Brandon Machine & Implement Works for the supply of lighting standards for the street illumination of Souris. These will consist of 13 five-light, 24 4-light, and 28 two-light standards. The order also includes 105 goose necks. The two and four-light standards are of the same design as the five-light with openings so that at any time the additional arms may be added. The five-light standards will be wired underground and the four and two-light overhead; for this latter purpose the company are making a three-inch pipe to slip inside the 3½-inch pipe in concrete with cross arm carrying wires at top.

South Vancouver, B.C.

The Board of Works has authorized the installation of a Gamewell fire alarm system.

Stonewall, Man.

This town was lighted by electric light for the first time in its history on December 12. Power is supplied by the Winnipeg Electric Railway Company.

St. Catharines, Ont.

Negotiations are proceeding between the city and the N. S. & T. Ry. Co. for the construction of a spur track on Welland Ave. to serve the Steel & Radiation Company.

St. John, N.B.

It is officially stated that the Grand Falls Company, Limited, will soon commence work on the erection of large pulp and paper mills at Grand Falls, on the St. John River, N.B. A large amount of power can be developed and transmitted to the towns and villages along the river. Sir William Van Horne is interested in the enterprise. Various schemes for the development of the falls have been proposed, but nothing practical was done until the present company took up the question. Engineers have been at work on the plans for several months.

St. Johns, P.Q.

The St. Johns Electric Company are installing a new electric lighting system on the streets, the supplies for which have just been received.

Tilbury, Ont.

A by-law will be submitted on January 5 authorizing the expenditure of $10,000 on an electric distribution plant.

Toronto, Ont.

The premises of the National Trust Company are being equipped with the Holmes Electric Protection Company's fire alarm and watchman's signal system.

A by-law will be submitted on January 1 authorizing the raising of $89,393, by the issue of debentures, to acquire a portion of the Mimico division of the Toronto & York Radial Railway Company's system.

City Solicitor Johnson has reported to the Board of Control that the only companies holding rights to enter the city by underground are the Hamilton Radial Electric Railway Company and the Hamilton, Waterloo & Guelph Railway Company.

The Forest Hill Electric Railway Company is said to be making ready to commence work on their line early in the spring. The first section of the road to be constructed, it is understood, will be from the city limits along Forest Hill Road to Eglinton Ave. and along Eglinton Ave. west.

Verdun, P.Q.

Under the bill of the city of Verdun, P.Q., introduced into the Quebec Legislature, power is given to construct conduits for telephone, telegraph, electric light and other wires. The bill also provides that no person or company shall erect poles in the streets for the purpose of stringing wires on them where a conduit has been built, and the city itself is not to have any such right, and neither can it grant any such permission except for poles for street lighting and for fire alarm wires. All persons or companies using the conduits will have to pay a tax to cover the cost of maintenance and interest charges. To carry out the scheme, power is asked to borrow $500,000.

Welland, Ont.

A by-law will be submitted at the January elections to raise funds for the installation of a fire alarm system. Estimates call for about $5,000.

Westmount, P.Q.

For the year ended October 31st the electric light department of Westmount, P.Q., showed a profit of $23,994, after deducting interest, sinking fund and depreciation of property. This profit has been spent on improvements, including a conduit and new lights on Western Avenue. The year, according to Mr. Grafftey, chairman of the committee, has been a most successful one in every way, chiefly due to the efforts of those employed in the department.

Winchester, Ont.

The village of Winchester is now being supplied with power and light by the Hydro-electric Power Commission of Ontario and in the near future it is expected that Chesterville, Williamsburg and Winchester Springs will be reached by the Commission's lines. At least one township has petitioned the Commission for light and power supplies for the farmers.

Winnipeg, Man.

A by-law was passed on December 12 authorizing the expenditure of $1,000,000 for extensions of their municipal hydro-electric system.

A contract for copper wire required by the municipal hydro-electric system has been awarded to the Eugene F. Phillips Company.

Commissioner Robson has issued a statement covering the financial condition of the municipal hydro-electric system up to date October 31, 1913. As published in our December 15 issue the deficit on April 30, 1913, was $142,274.64. To this is now added the deficit of the next six months of $24,713.94 making a total deficit at October 31, 1913, of $166,988.58. This is after making all the necessary allowances for depreciation, sinking fund and interest on floating debts.

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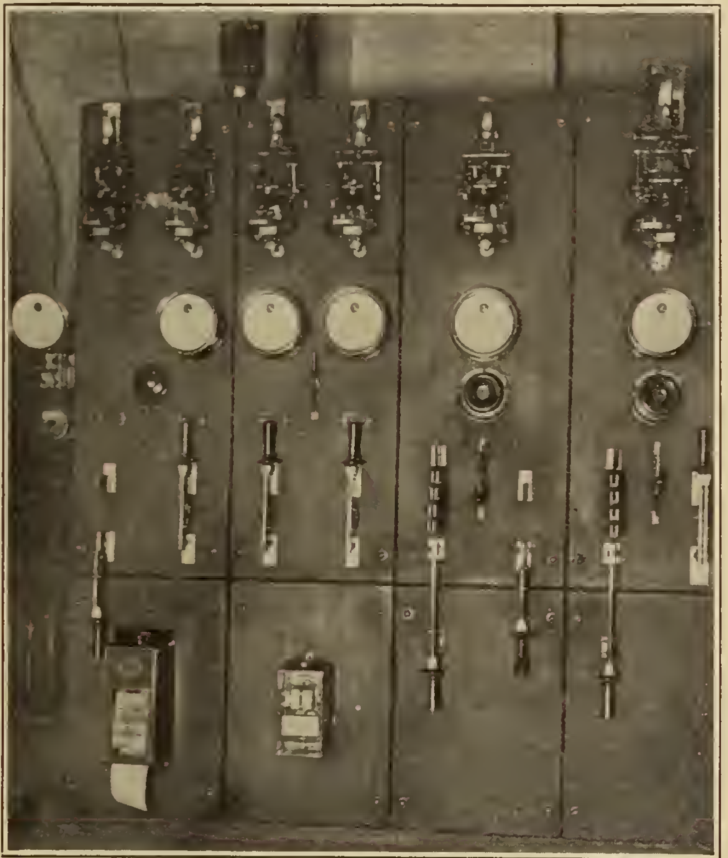

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Publisher's Notice

Advertisements under "Situation Wanted" "Situation Vacant" or Miscellaneous, are charged at 2 cents a word per insertion, minimum charge 50 cents.

Advertisements for tenders, equipment, wanted or for sale, etc., are charged at $2.10 per inch.

All advertisements must be in the publisher's hands by the 10th or 23rd of the month to insure insertion in the subsequent issue.

FOR SALE

Owner of Canadian Patent No. 148591, on the "Uni-Sectional" Switch and Outlet Box, would like to arrange for the manufacture and sale of the device in Canada. Will sell patent outright or arrange on a royalty basis. The box is a proven seller in the States. Address Otto Moessner, 703 Oak Lane, Philadelphia, Pa. 1

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Bought, sold, rented, and exchanged. We have the largest stock in America. Send for our monthly bargain sheet showing complete stock with our prices.

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A second hand 75 h.p., a.c., 550 volt, 3-phase, 60 cycle, 850 r.p.m., slip ring motor. State make and age of machine; also if starter and controller are included in equipment. Address: Manager, Carsons Hygienic Dairy Co., Winnipeg, Man. 1

Position Wanted

Civil engineer of four years' standing, familiar with transit and level work, design of switchboard and power plant, is open for position. Speaks English and French. Has also experience in underground conduit work. First class draughtsman. A practical man. Apply Box 927, Electrical News, Toronto. 1

Wanted Employees

WANTED—Experienced man to take charge of meter testing in sub-stations and central stations. Salary $90 per month to start. Good chance for advancement.

Northern Ontario Light & Power Company,
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Wanted—Electrical man with knowledge of gasoline engines, to sell and erect small isolated electric light installations. Good opportunity for young man. Reply giving age, experience and salary required to Box 916 Electrical News, Toronto. F

WANTED—A man preferably not over thirty years old to take charge of high tension substation and distributing system for lighting, and power service to three small growing towns with aggregate population of 4,000.

Applicants should state age, whether married or single, salary expected and give a detailed account of experience in operating and constructing distributing systems and in soliciting new business. Address "Substation," c/o Electrical News, Toronto. 24-1

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"Tesla High Frequency Coil," by Haller & Cunningham. Published in 1910 by D. Van Nostrand & Company. Price $1.25.

'Elementary Telegraphy," by Pendry. Published in 1910 by Whittaker & Company. Price $1.00.

"Practical Testing of Electric Machines," by Oulton & Wilson. Published in 1909 by Whittaker & Company. Price 75c.

'Wireless Telegraphy Construction for Amateurs," by Morgan. Published in 1910 by D. Van Nostrand & Company. Price $1.50.

'Direct and Alternating Current Testing," by Bedell. Published in 1909 by D. Van Nostrand & Company. Price $2.00.

"A Laboratory Manual of Alternating Currents" by John H. Morecroft, E.E. Published in 1912 by Renouf Publishing Company. Price $2.00.

'Modern Electrical Construction," by Henry C. Horstmann and Victor H. Tousley. Published in 1911 by Frederick J. Drake & Co. Price $1.00.

"Electricians' Operating and Testing Manual," by Henry C. Horstmann and Victor H. Tousley. Published in 1910 by Frederick J. Drake & Company. Price $1.50.

"Telephony," by Samuel G. McMeen and Kempster B. Miller. Published in 1912 by the American School of Correspondence. Price $3.00.

"Elevators, Hydraulic & Electric," by Calvin F. Swingle. Published in 1910 by Frederick J. Drake & Company. Price $1.00.

"Practical Mathematics for the Engineer and Electrician," by Elmer E. Burns and Joseph G. Branch. Published in 1912 by the Joseph G. Branch Publishing Company. Price $1.00.

"The Electric Motor and Its Practical Operation," by Elmer E. Burns. Published in 1912 by Joseph G. Branch Publishing Company. Price $1.00.

'Alternating Currents Simplified," by Elmer E. Burns. Published in 1912 by the Joseph G. Branch Publishing Company. Price $1.00.

"Wireless Telegraphy and Telephony Simply Explained," by Alfred P. Morgan. Published in 1913 by the Norman W. Henley Publishing Company. Price $1.00.

"Experimental Wireless Stations," by Philip E. Edelman. Published in 1912 by Philip E. Edelman. Price $2.00.

"Electric Wiring & Lighting," by Charles E. Knox, E.E. Published in 1913 by the American School of Correspondence. Price $1.50.

"Electric Arcs," by Clement D. Child, Ph.D. Published in 1913 by D. Van Nostrand Company. Price $2.00.

"Conversations in Electricity," by Branch. Published in 1908 by the Branch Publishing Company. Price $2.00.

'A. C. Machinery," by Esty. Published in 1912 by the American School of Correspondence. Price $4.00.

'Wireless Telegraphy and Wireless Telephony," by Ashley-Hayward. Published in 1911 by the American School of Correspondence. Price $1.50.

Order at once if interested.

Book Department

Electrical News

220 King Street West - Toronto, Ontario

Special Prices

ON

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The Steam Turbine, by Robert M. Neilson. Published in 1903 by Longmans, Green & Co., 294 pages, illustrated. Price $1.00.

Telegraphy, by Sir W. H. Preece, K.C.B., and Sir J. Sivewright, M.A. Published in 1905 by Longmans, Green & Co., 504 pages. Price $1.00.

Electro-Dynamos, by Charles Ashley Carus-Wilson. Published in 1898 by Longmans, Green & Company, 298 pages. Price 50c.

Electrical Engineering, by Steinmetz. Published in 1909 by McGraw Hill Publishing Company. Price $3.00.

Radiation, Light & Illumination, by Steinmetz. Published in 1909 by McGraw Hill Publishing Company. Price $2.50.

Alternating Current Motors, by McAllister. Published in 1909 by McGraw Hill Publishing Co. Price $2.00.

Electric Motors, by Crocker & Ardendt. Published in 1910 by D. Van Nostrand & Company. Price $2.00.

Direct & Alternating Current Manual, by Bedell. Published in 1911 by D. Van Nostrand & Company. Price $1.00.

Short Course in Testing Machinery, by Morecroft and Hehrs. Published in 1911 by D. Van Nostrand & Company. Price $1.

Dynamo Electrical Machinery, by Sheldon & Hausman. Published in 1910 by D. Van Nostrand & Company. Price $1.50.

Electricity—Experimentally and Practically Applied, by Ashe. Published in 1910 by D. Van Nostrand & Co. Price $1.00.

The Dynamo (2 volumes), by Hawkins & Wallis. Published in 1909 by Whittaker & Company. Price $4.00.

Hydro-electric Developments and Engineering, by Koester. Published in 1909 by D. Van Nostrand & Company. Price $4.00.

Electric Meters, by Jansky. Published in 1913 by McGraw Hill Publishing Company. Price $2.00.

Steam Turbines, by Kennedy. Published in 1910 by Whittaker & Company. Price $1.00.

Dynamo-Electric Machinery, by Francis B. Crocker, E.M., Ph.D. Published in 1908 by American School of Correspondence. 236 pages, illustrated. Price $1.00.

Telephone Law, by A. H. McMillan. Published in 1908 by McGraw Publishing Company. 332 pages. Price $1.50.

Practical Methods of Electro-Chemistry, by F. M. Perkin, Ph.D. Published in 1905. 322 pages. Price $1.00.

Treatise on Thermodynamics, by Dr. Max. Planck. Published in 1903. 272 pages. Price $1.00.

Text-Book of Electrochemistry, by Svante Arrhenius. Published in 1902. 344 pages, illustrated. Price $1.00.

Electric Circuit Theory and Calculations by W. Perren Maycock, M. I. E. E., published by Whittaker & Co., 1913, (Just out), Price $1.00.

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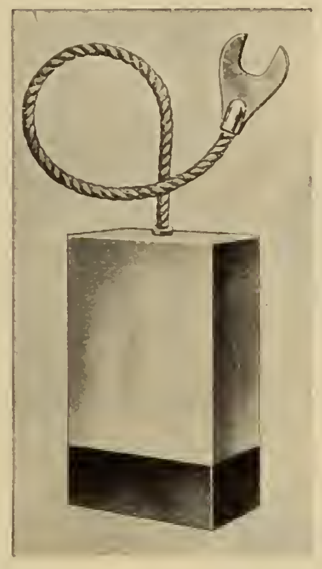
220 King Street West - Toronto, Ontario



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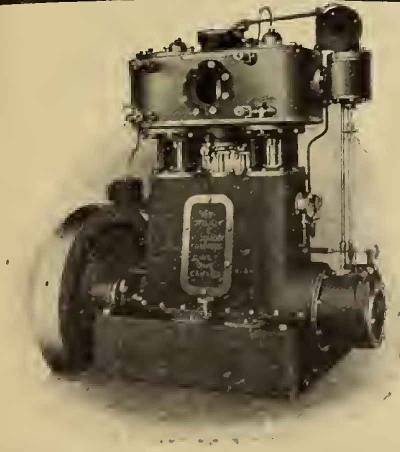

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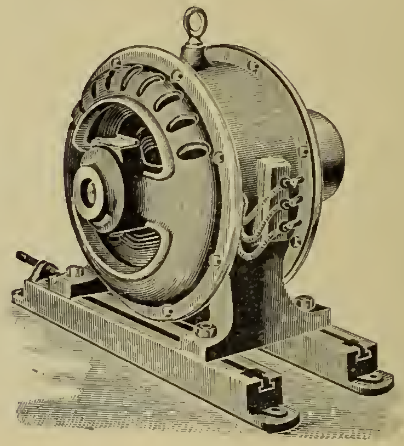

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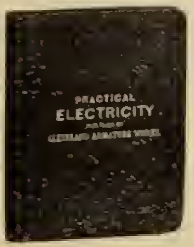

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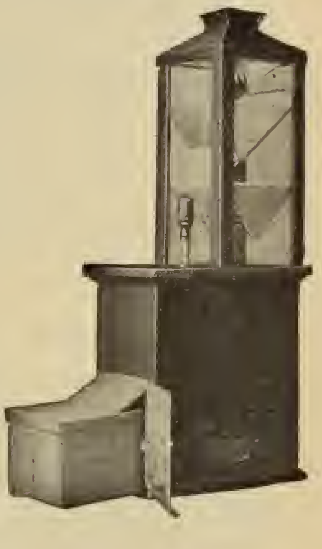
With Street Railway men is the Fare Box—a system which has gained favour wherever tried. The safest box made is the Cleveland. All nuts, screws, and bolts are inserted from the inside, and the cash box automatically locks itself when being removed.



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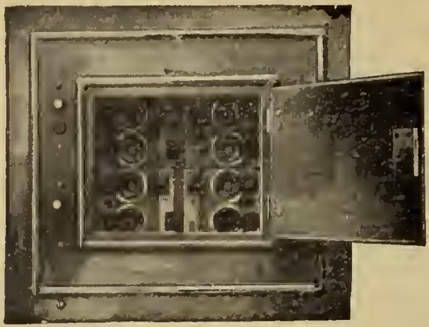

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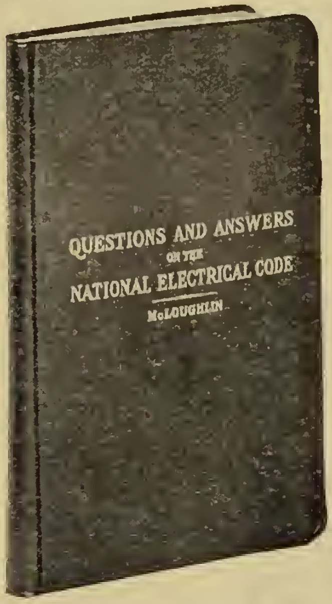

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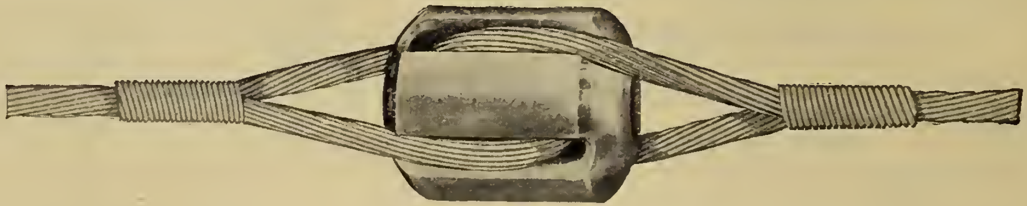

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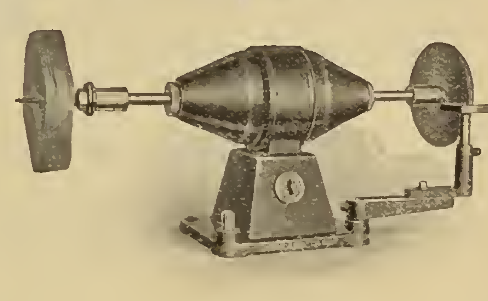

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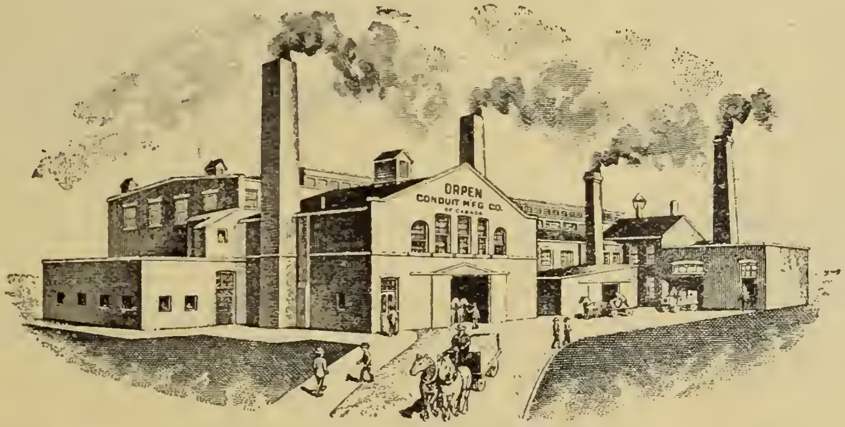

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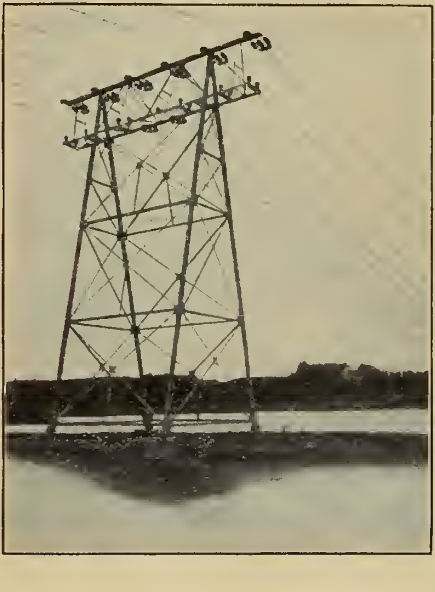

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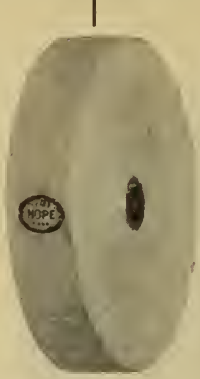

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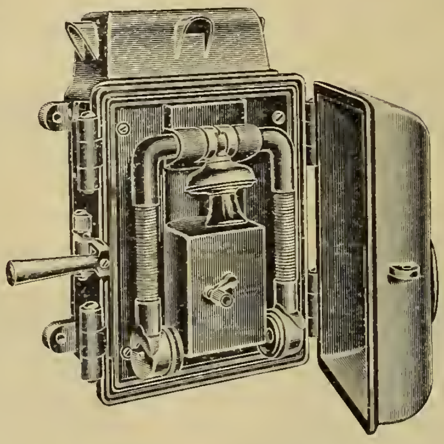

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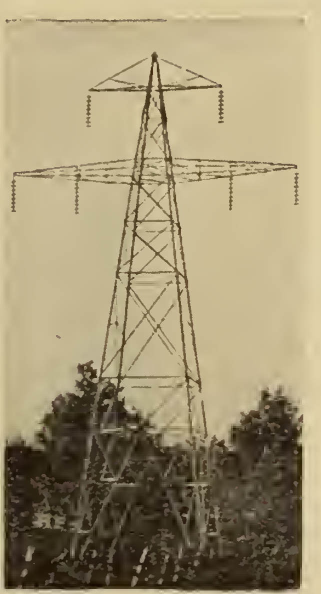

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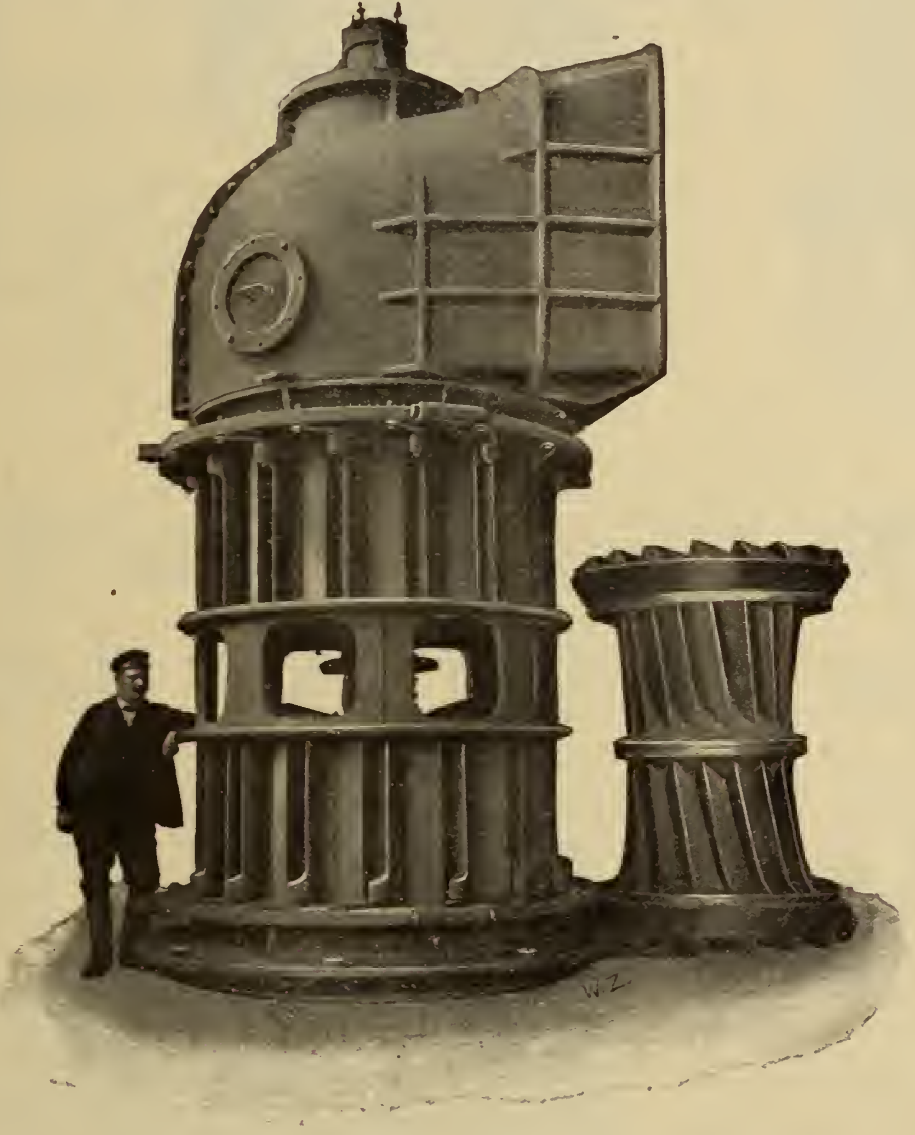

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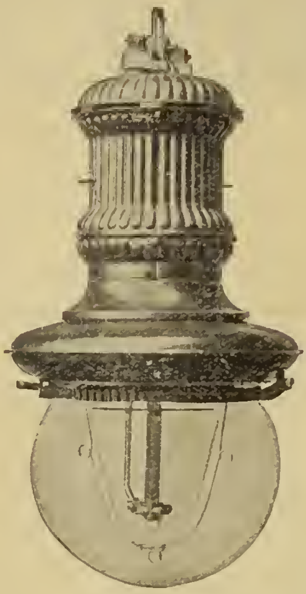

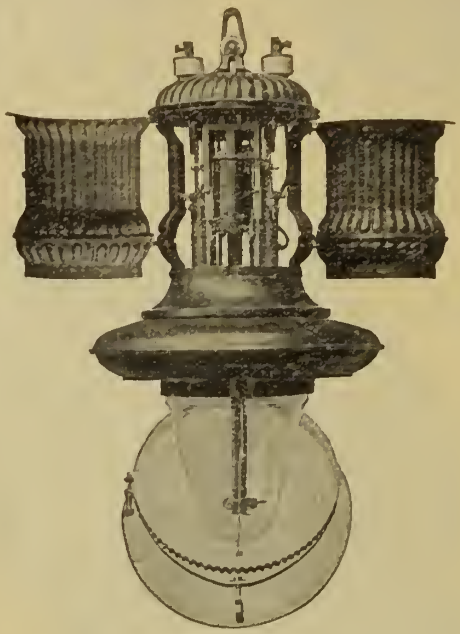

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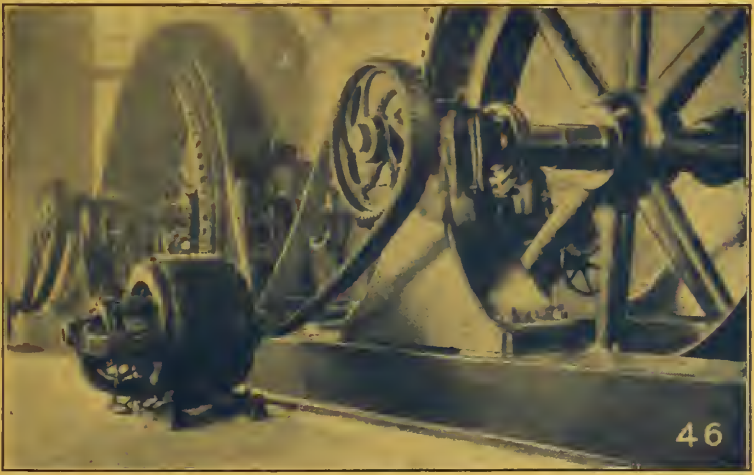

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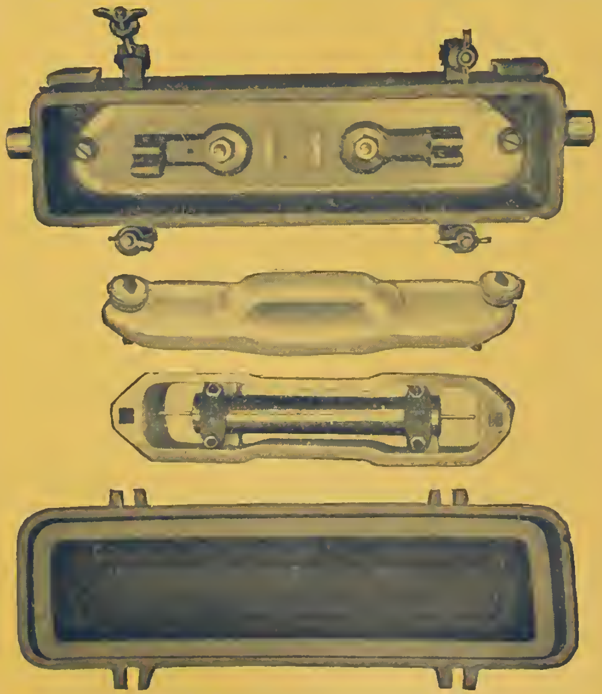

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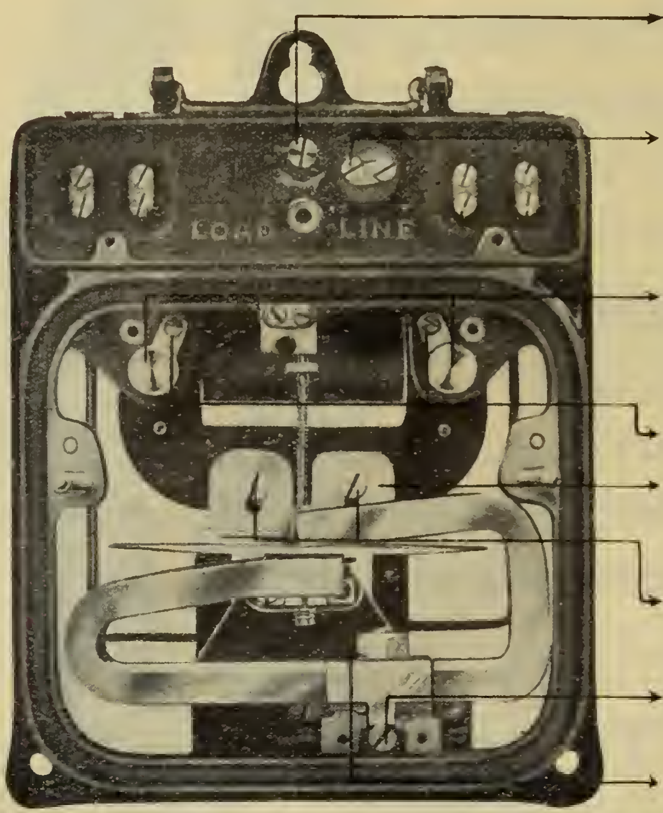

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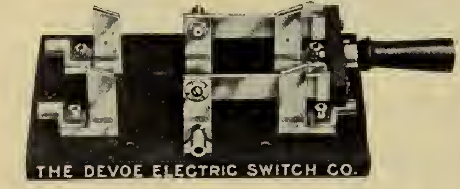
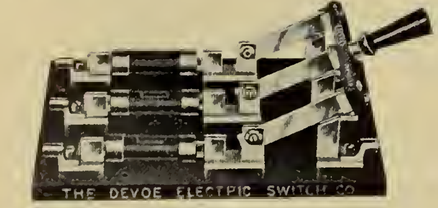
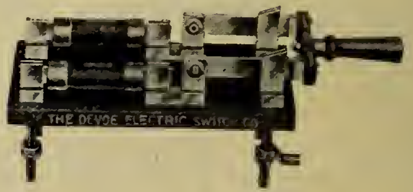
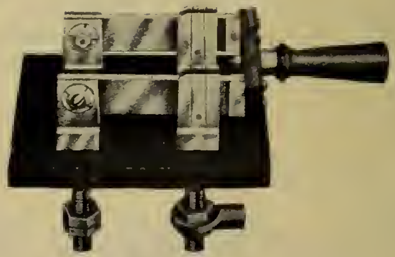




Write for Switch Catalogue No. 6 and Box Bulletin No. 2.

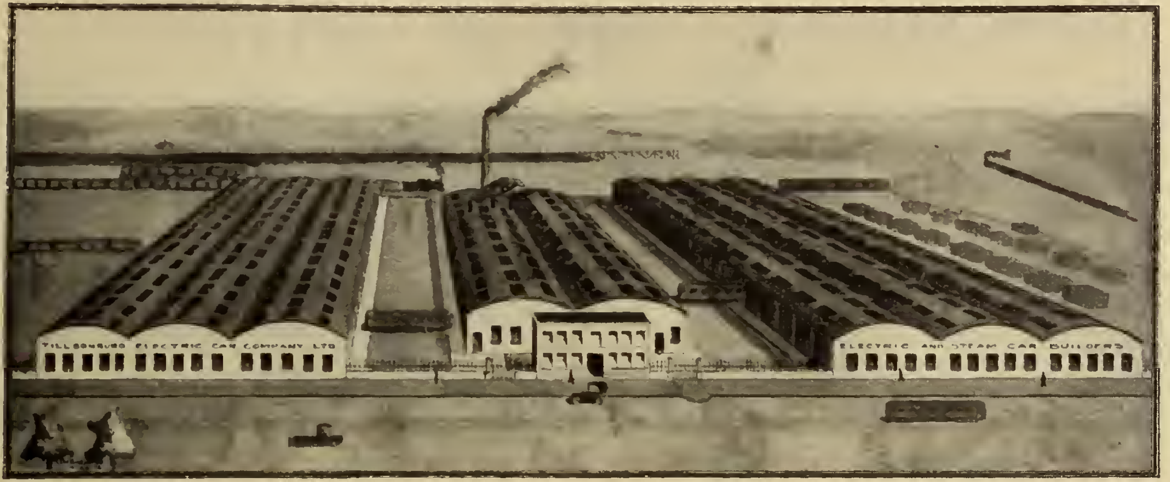




Send us your Specifications.

Office and Factory: No. 157 Craig St. West, Montreal

Frank G. Scofield, Ontario Sales Representative, Lumsden Building, Toronto, Ontario


TILLSONBURG ELECTRIC CAR COMPANY LTD
ELECTRIC AND STEAM CAR BUILDERS

The Tillsonburg Electric Car Co., Limited

Manufacturers of

ELECTRIC CARS, SWEEPERS AND SPRINKLERS

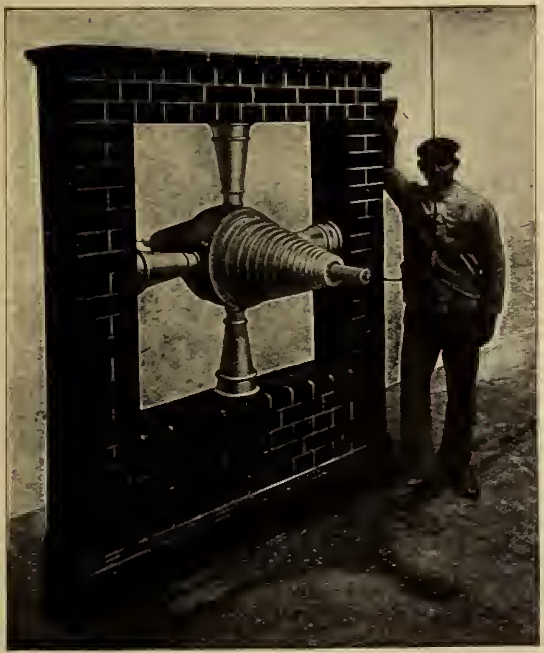
The above illustration shows our new plant. Part of which is already erected at Tillsonburg and in operation.

The latest types of machinery have been installed and experienced workmen employed, and we are now ready to fill orders for any of our products promptly and satisfactorily.

Cut out this advertisement for future reference—an order placed with us will save you time and money.

Office and Works, - - Tillsonburg, Ontario

Porzellanfabrik Hermsdorf



Sachsen-Altenburg, Germany

Wall Duct for the High Tension
Transmission Station of the

**Hydro-Electric Power
Commission of Ontario**

110,000 Volts

Sole Agents for Canada

Watson Jack & Company

709 Power Building, MONTREAL

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The Best Endorsement of the value of the "Electrical News" as an advertising medium is the above List of Advertisers

Maple Leaf Elevators, Port Colborne, Ont. "GALVADUCT" Buildings

LORICATED

"GALVADUCT"

The most perfect interior construction conduit on the market.
Recognized as the standard of high quality.

Always specify Galvaduct or Loricated CONDUITS

Everywhere the largest buildings, industrial plants and power companies have their electric wiring safely harboured in the world's most famous conduits—Galvaduct and Loricated.

"LORICATED"

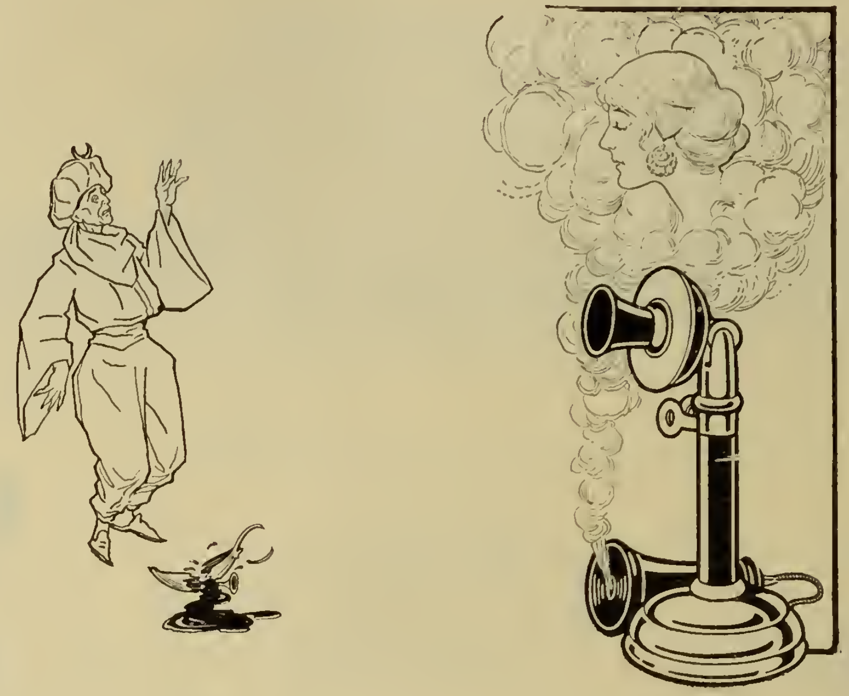
A high-class interior construction conduit of the enamelled type, proof against acid or other corrosive agents.

If your jobber cannot supply you—write us.

Conduits Company Limited.

Toronto - Montreal

GALVADUCT



THE WONDER OF THE TELEPHONE

ISN'T it amazing, when you stop to think of it, the wondrous rapidity with which we are able to communicate with people at great distances.

The Kellogg Company is a pioneer in the telephone field and has contributed many improvements to its development. Our equipment will give the highest class service at the lowest cost.

Write for further information and prices.

KELLOGG SWITCHBOARD AND SUPPLY COMPANY

MAIN OFFICE AND FACTORY, - - CHICAGO, ILL.

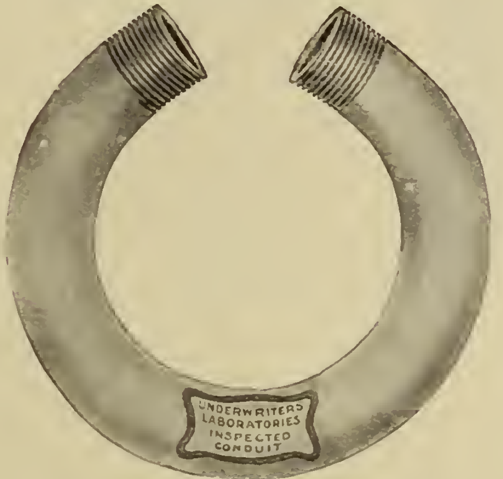
CANADIAN SALES OFFICE: DEERING ELECTRIC LIMITED—REGINA

Conduit and Accessories

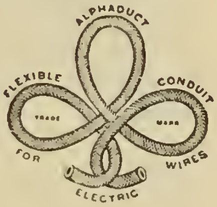
Approved by National Board of Fire Underwriters

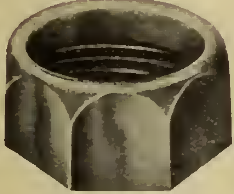
GREENFIELDUCT

No. 6350

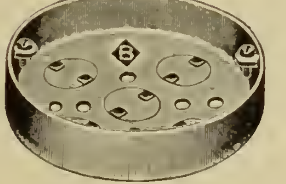


Hot Galvanized

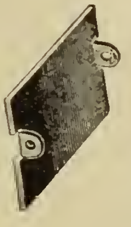


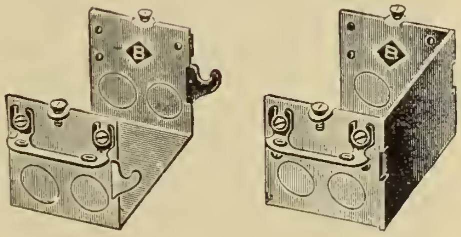


Bushing



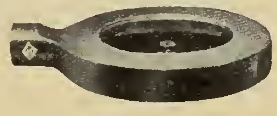
18 L





C C S Box

Type E



Type P

Type L B

Type H

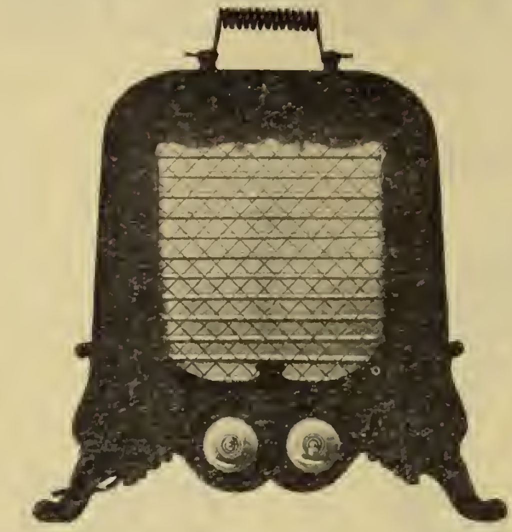
Type J

Ask For Catalogue No. 4

Electrical Fittings Company, Limited

Toronto - Canada

Real Red Heat



Bastian Electric Heaters

Red Hot Glowing Quartz.

Heating Elements Guaranteed Against Burnout for Four Years.

THE MASCO CO., Ltd.

Complete Stock.
Information on request.

Toronto

THE
MANHATTAN
Electrical Supply Co.

Manufacturers of
Telegraph and Telephone Instruments and Supplies
Wireless Outfits
Fire and Burglar Alarm Apparatus
Annunciators Letter Boxes Speaking Tubes
Electric Heating and Cooking Apparatus
Electric Bells—Push Buttons
Testing Instruments

Ignition Apparatus
Automobile and Motor Boat Supplies
Medical Batteries—Massage Vibrators
Electric Toys and
The Red Seal Dry Battery

"Something Electrical for Everybody."

For catalogues and full information address

FRANK G. SCOFIELD
REPRESENTATIVE FOR ONTARIO
702 LUMSDEN BLDG. - TORONTO, ONT.

A SUGGESTION FOR THE NEW YEAR
SPECIFY

TRANSFORMERS
INSTRUMENTS
METERS
MOTORS
WIRING DEVICES
ARC LAMPS
CARBON LAMPS
MAZDA LAMPS

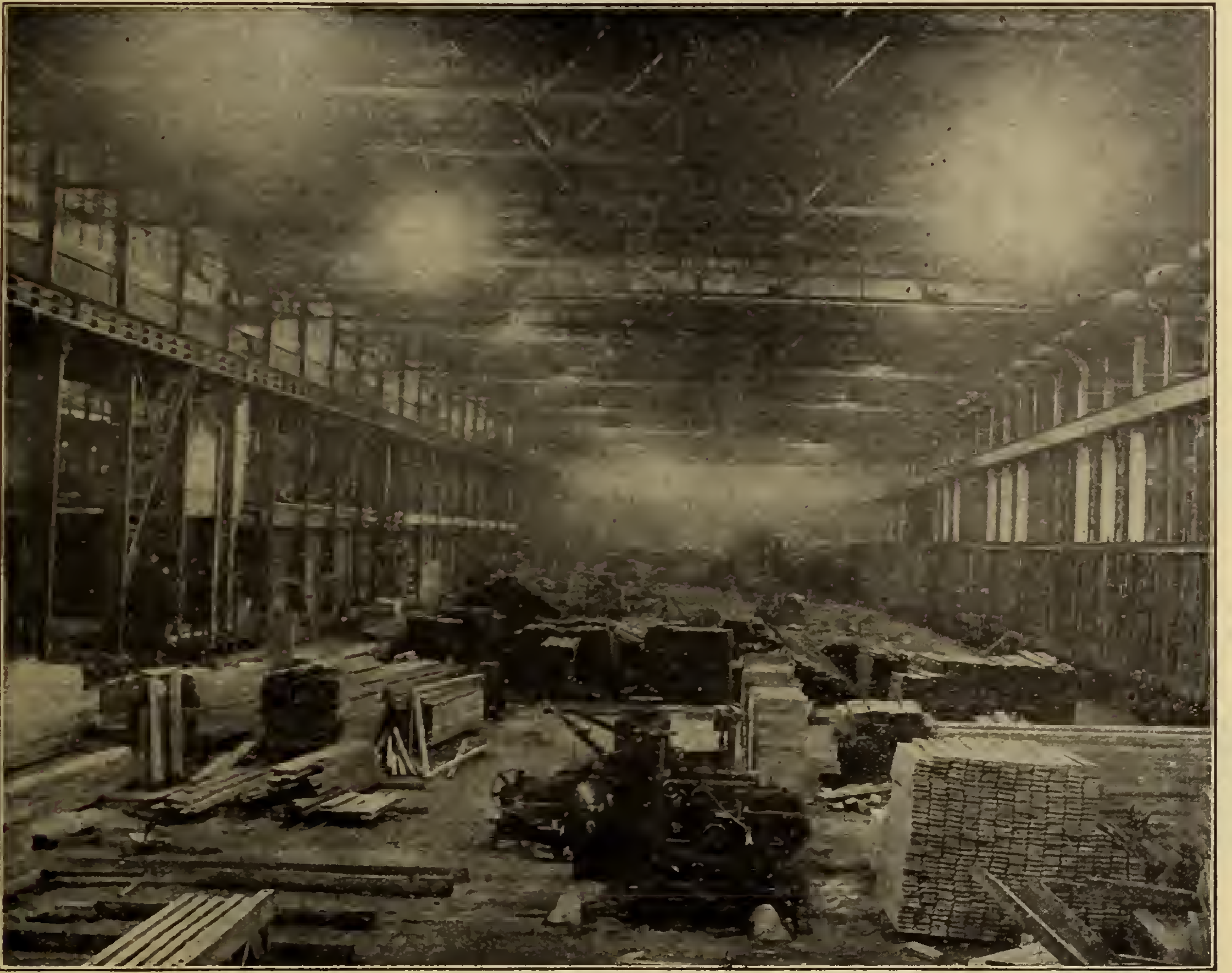
GENERATORS
SWITCHBOARDS
CIRCUIT BREAKERS
LIGHTNING ARRESTERS
RECTIFIERS
HEATING GOODS
WIRES AND CABLES
RAILWAY SUPPLIES

SUPPLIES

If your problem requires information based on a wide range of electrical manufacturing experience you will obtain this service through the co-operation of our nearest district office.

CANADIAN GENERAL ELECTRIC CO.,
LIMITED
HEAD OFFICE - TORONTO
Montreal Halifax Ottawa Cobalt Porcupine Fort William Winnipeg Regina
Saskatoon Calgary Edmonton Nelson Victoria Vancouver Prince Rupert

AN EXAMPLE OF GOOD LIGHTING BY TYPE W FLAME ARC LAMPS



The above is a photograph of the woodworking shop of The Eastern Car Co., New Glasgow, N.S., length 1000 feet, width 90 feet, illuminated by twenty-two Type W Flame Arc Lamps. The diffusion is very good, and fine print can be read anywhere in the building.

The Eastern Car Co. have four buildings as large as the one photographed, all illuminated by Type W Flame Arc Lamps. They use a total of about one hundred and four lamps. For a full description of this lamp see our

Bulletin Y 210

CANADIAN GENERAL ELECTRIC CO.

LIMITED

Head Office: TORONTO

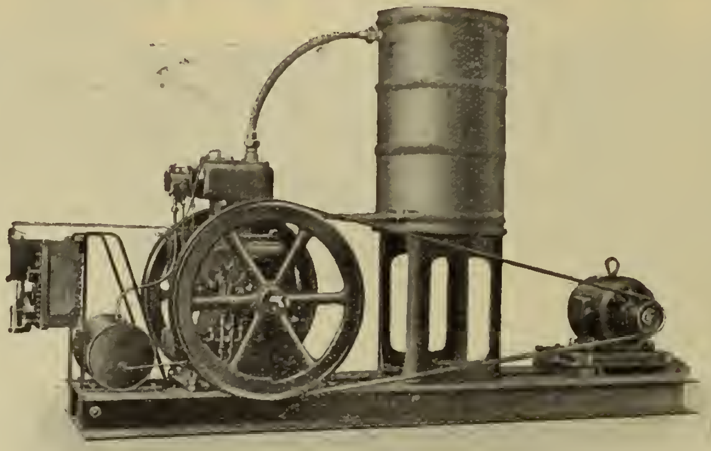
District Sales Offices: Montreal, Halifax, Ottawa, Cobalt, Porcupine, Fort William, Winnipeg, Regina, Saskatoon, Calgary, Edmonton, Nelson, Vancouver, Victoria, Prince Rupert

The LISTER-BRUSTON

AUTOMATIC ELECTRIC LIGHTING PLANT

Are you interested in the lighting of

- Country Houses
- Hotels
- Summer Homes
- Churches
- Factories
- Small Towns
- Villages?



A Few Purchasers

Canadian Bank of Commerce. 8 plants.
Shawville Municipality, Que. 2 plants.
House of Refuge, Cornwall, Ont.
Cleveland House, Hotel, Minett P.O., Ont.
Campbell Reeves, Esq. (Jno. Inglis Co.), Toronto.
R. A. Manning, Esq., Barrie, Ont.
Dr. Ellen Burt-Sherratt, 7 Dundonald St., Toronto.
R. Scoles, Esq., New Carlisle, Que.
W. Mosley, Esq., Weston, Ont.
R. Gordon Stewart, Esq., Ottawa, Ont.
N. Trotter, Esq., Little Current, Manitoulin Island, Ont.
Chas. Lewis, Esq., Lansing, Ont.

THIS PLANT generates electricity automatically and does away with the necessity of large expensive storage batteries. With the exception of keeping it clean, lubricating and filling the gasoline supply tank, no attention is required. In addition to these advantages the first cost is low, space required small and no foundations are necessary. It is delivered practically ready for connecting up to the house wiring, and can consequently be used within a few hours of being unpacked.

R. A. LISTER & COMPANY, LIMITED

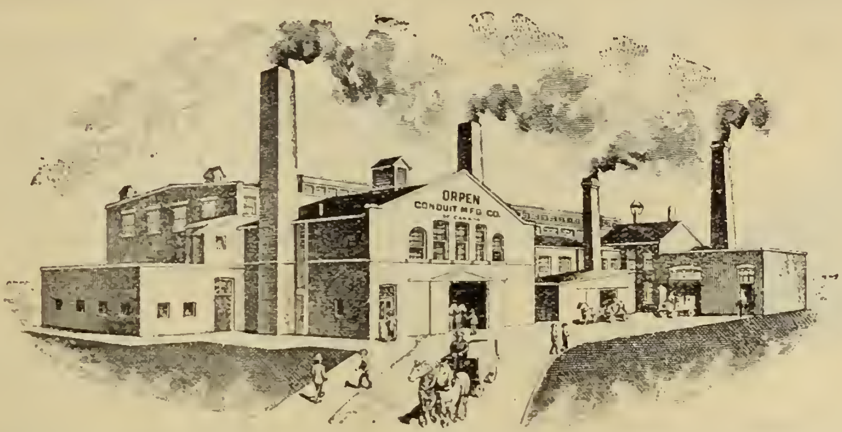
Winnipeg **58-60 Stewart St., TORONTO** **St. John, N. B.**

OUR Best Wishes for a Happy and Prosperous New Year to our many friends who have made us the largest Electrical Supply House in the West.

Mainer Electric Company, Limited

Winnipeg, Man. ***Edmonton, Alta.***

The home of
XCELADUCT
and
ORPENITE
CONDUITS


ORPEN CONDUIT MFG. CO.

Queen
and
Dufferin
Streets
TORONTO

"XCELADUCT"

"Xceladuct" is a high grade of galvanized conduit made of easy-bending spellarized steel tubing, doubly protected against rust by copper plating and zinc coating. Every length is made up with clean threads and smooth enameled interior, allowing easy and rapid fishing.

INTERIOR

ORPEN CONDUIT MANUFACTURING CO. of CANADA
MANUFACTURERS OF XCELADUCT ORPENITE CONDUITS
HEAD OFFICE TORONTO ONTARIO

Let us send
Prices and Samples

CONDUITS

"ORPENITE CONDUITS"

"Orpenite" Enameled Conduit is made of easy-bending spellarized steel tubing which is protected against rust and proof against all temperature conditions by coatings of specially prepared enamel. Each length presents clean threads and a smooth interior permitting of easy and rapid fishing.

THE ORPEN CONDUIT MANUFACTURING COMPANY of CANADA
TORONTO MONTREAL

"Monarch Pull Socket"

ALL CANADIAN

Created in Canada
Made in Canada
Patented in Canada
For Canadians
Why not save duty charges

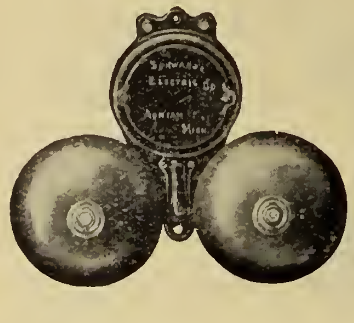
These sockets have been in satisfactory service for a year.

Snap cap and shell

Made and sold by

Monarch Electric Company, Limited
ST. LAMBERT, QUE.

Write for prices



We Have a Bell For Every Purpose

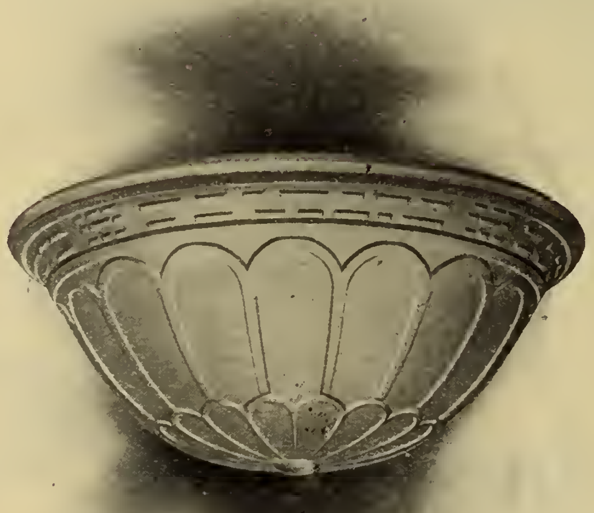
There can be only **one best** and that is the **Schwarze**. **No. 12 Common Magneto Extension** for telephone Service is illustrated herewith. The spools are large enough so that in no case is it necessary to use over No. 35 magnet wire, thereby obtaining the maximum number of ampere turns, and this wire **is all active**. Armature is under influence of coils its entire length. Poles arranged so that permanent magnet cannot be discharged, and will not weaken.

No. 13, same as No. 12, except larger and **very much louder**, and is for signalling purposes on high tension 60 cycle. Fully approved by Underwriters.

All weatherproof. Write for catalogue. **All resistances.**

Schwarze Electric Co., Adrian, Michigan

Norton Telephone Co., Canadian Agents



No. 6052—18 in.
MOONSTONE SEMI-INDIRECT BOWL.

Another New Design in "MOONSTONE"

WE illustrate here another recent creation of our designers. It is, we think, one of our most artistic and efficient semi-indirect bowls.

Lends itself very appropriately to the special tintings in which "MOONSTONE" has become very popular for decorative purposes.

Ask for a copy of our new catalog.

Jefferson Glass Co.
Limited
Toronto ∴ Ontario

DAUM REFILLABLE FUSES

Refilled by simply bending the fuse over the metal cross piece and screwing the cap in place.

No threads on the fibre tube to strip off or screws, rivets or clamps to get loose. Merely two holes in the fibre tube and held in place by the cap. This metal to metal contact is not affected by the swelling or shrinking of the fibre shell.

Daum Fuses are making good every day.

CATALOGUE NO. 17 for the asking

Sole Manufacturers
A. F. DAUM COMPANY, PITTSBURGH, PA.

DOSSERT CONNECTORS

have been recently referred to by the chief executive of a great Edison Company as good examples of the genius of DOING AN ORDINARY THING IN AN EXTRAORDINARY WAY. Joints made up in the Dossert way are simple and good electrically and mechanically. They effect extraordinary economies in labor and materials and never fail when subjected to overloads that would cause burnouts in soldered joints.

DOSSERT & CO., 242 West 41st St., NEW YORK
H. B. LOGAN, PRESIDENT
IRVING SMITH. Canadian Rep., Unity Bldg., MONTREAL

Build a Business

on

Northern Light

Take a survey of your city or town.

You will find many poorly lighted stores, shops and factories in which otherwise competent workers are wasting energy and ruining their eyesight.

Here is a new field of business for you—a big field. Develop it!

Prove to the heads of these places how a rearrangement of their lighting systems will increase efficiency and reduce costs in their plants.

Demonstrate how Northern Light Mazda Lamps equipped with the proper reflector can be installed to meet their particular requirements.

Big business in lighting awaits the man who will go after it.

Be that man in your town.

At any time you wish it the lighting specialist at our house nearest you will help you solve the lighting problems of your prospective customers.

THE Northern-Electric
AND MANUFACTURING CO. LIMITED

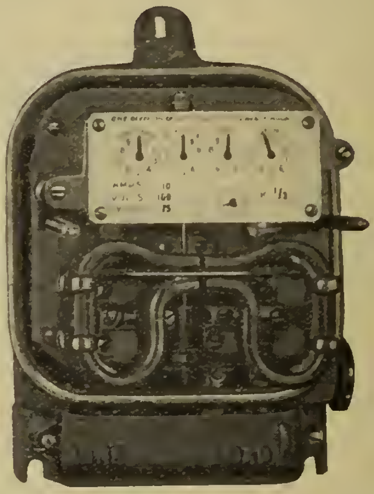
Montreal Halifax Toronto Winnipeg
Regina Calgary Edmonton Vancouver Victoria

Packard

The Meter with a Reputation

Type "K" Meter

Meter with Glass Case giving clear view
of interior mechanism.



Meter without case, showing improved magnet
support and light load adjustment.

Large Stocks Carried at

St. Catherines and Winnipeg; St. John Railway Co., St. John, N. B.; General Supplies, Limited, Calgary, Alta.; Rudel-Belnap Machinery Co., Canadian Express Bldg., Montreal, P. Q.

The Packard Electric Co., Limited

Factory at St. Catharines, Ont.

*General Sales Office,
Traders Bank Bldg., TORONTO*

*N. W. Office and Warerooms
WINNIPEG*

One of a hundred adaptations of the

Campbell Automatic Time Switch

Switches any light, all lights, any time you wish.

Weather tight, gas tight, tamper tight—and you visit it once in 8 days.

Send for Catalog Lookit up.

Campbell Electric Co.

LYNN, MASS.

Canadian Representative—Irwin Smith, 809 Unity Bldg. Montreal

This Building

5 Floors to Let

Adelaide St. W., Toronto

When completed this will be the most attractive warehouse building in the city. The exterior, the entrances, the elevators, etc., bear all the earmarks of a high class office building.

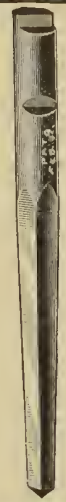
Special Features

Centrally situated
Light on four sides
Passenger and freight elevator
Vaults
Low insurance
One block from four car lines
Floor area, 6,300 sq. feet, each floor.

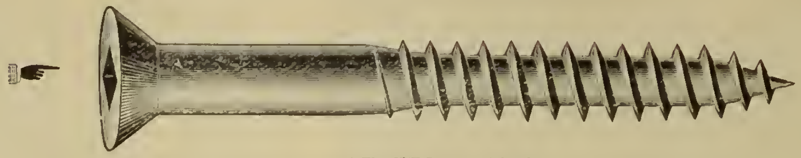
For further particulars ask

R. A. Donald

Union Bank Building - Toronto



SEE
THAT
SQUARE
HOLE



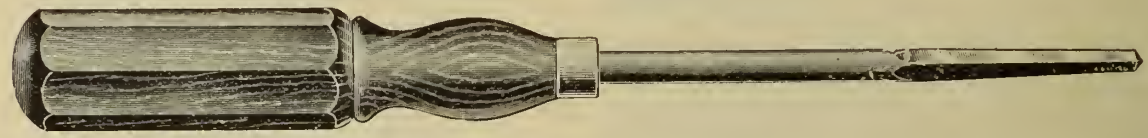
PAT. FEB. 2, 1909

SOCKET HEAD
Wood Screws

The advantages of this wood screw are many. The screw may be placed on the driver and driven at arms length, with one hand. It is impossible for the driver to slip out of the socket.
Drivers are made in a variety of suitable styles.
For electrical wiring and fixture work, etc. this type of screw is unrivalled.

Samples, prices and catalogue on request.

The P. L. Robertson Manufacturing Co., Ltd.
Milton — Ontario



"Eclipse" Electric Heaters

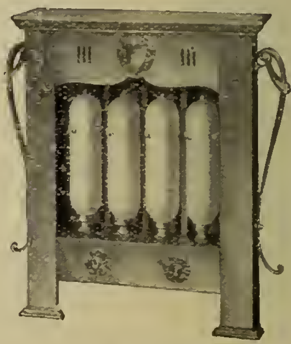
5 Years Guarantee

A patented System, in Successful use all over the World.

Our Catalogue illustrates and describes our 100 patterns.

No. 332 Connector

No. 388 Train and Car Heater



No. 405 Radiator

Can be procured in Canada from the Supply Authorities,
Electrical Dealers, or from our Montreal office as under.

The Electric & Ordnance Accessories Company Limited
Head Office for Canada :—LEWIS BLDG., MONTREAL
Mr. J. P. I. Thomas (Representative)
Works :—Aston, Birmingham
ENGLAND

If You Are Interested

in prompt shipments, at economical prices, of high grade

Bare Copper Wire
Weatherproof Wire
Rubber Insulated Wire

we solicit your inquiries.

We have large, fresh stocks of these materials and can make immediate shipments of orders, large or small.

Write to-day to our nearest office for quotations.

Standard Underground Cable Company of Canada, Limited
Hamilton, Ont.

Montreal, Que. Winnipeg, Man.
Boston, Mass. Seattle, Wash.

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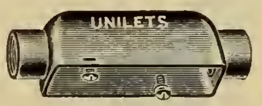

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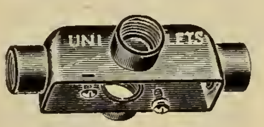

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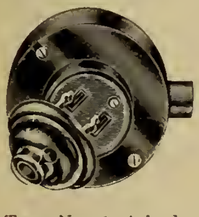
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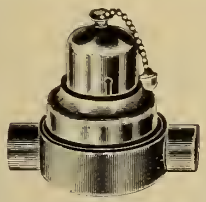
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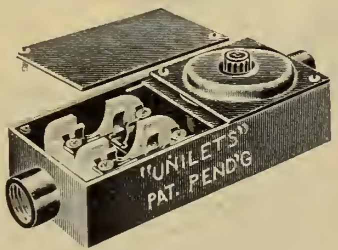

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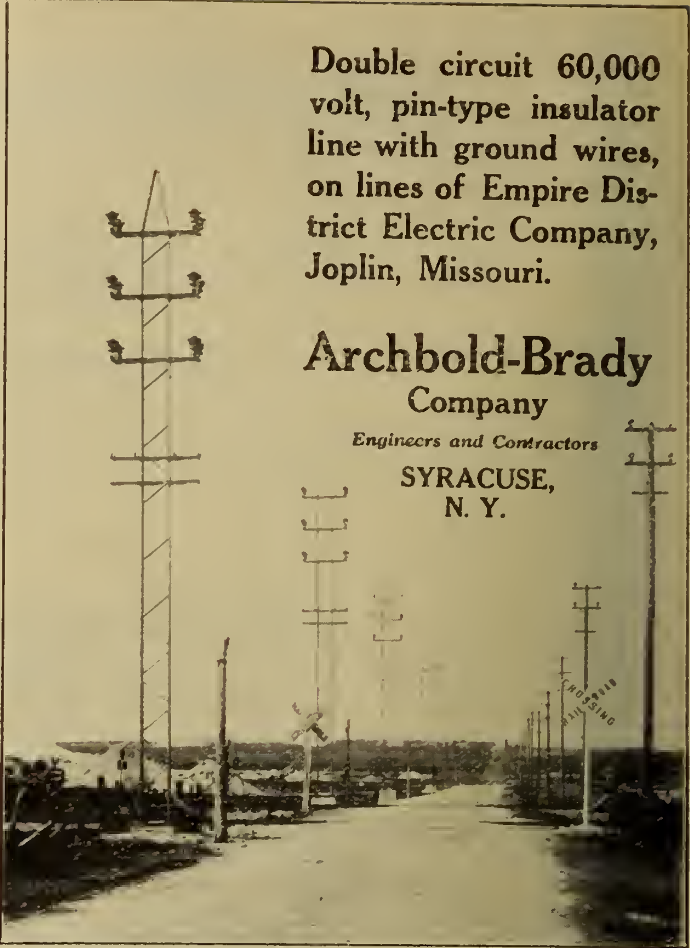

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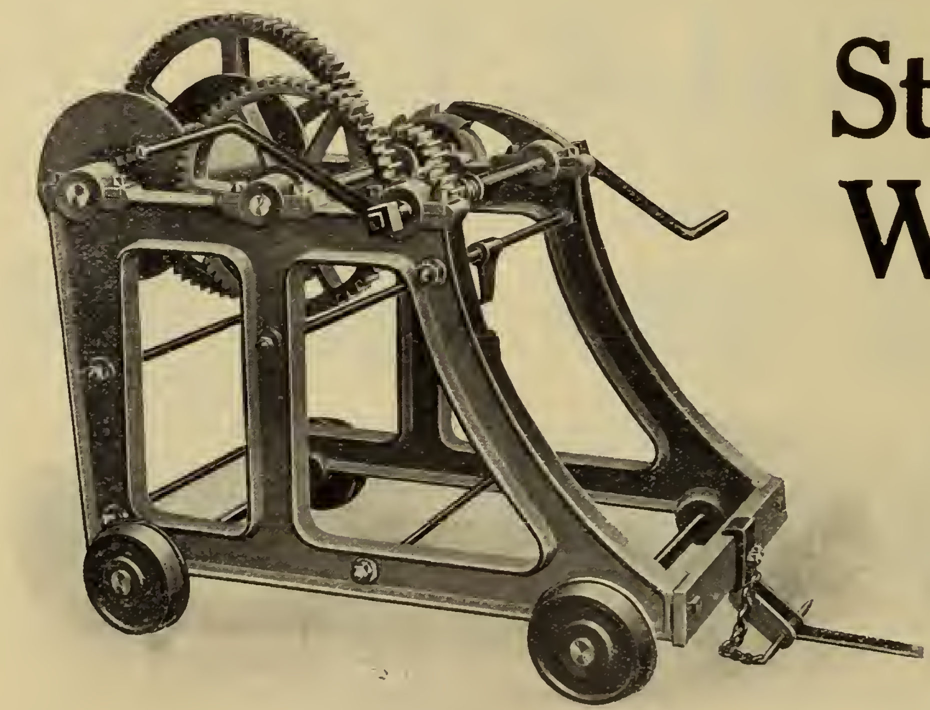

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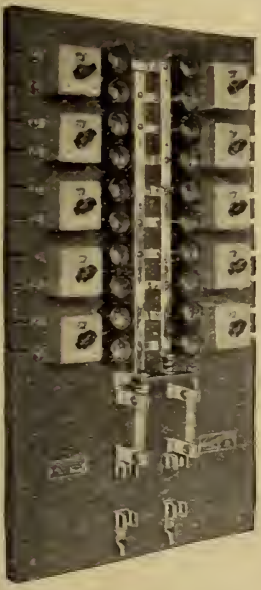

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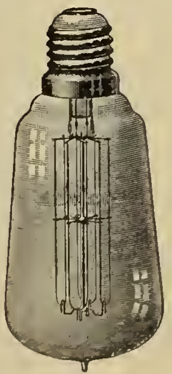

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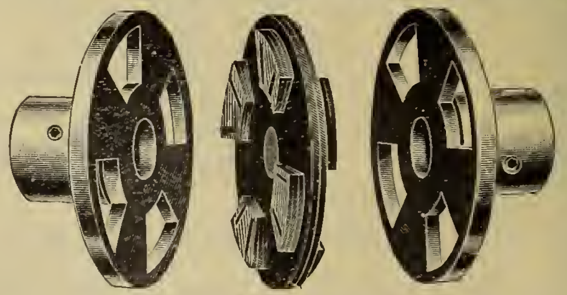

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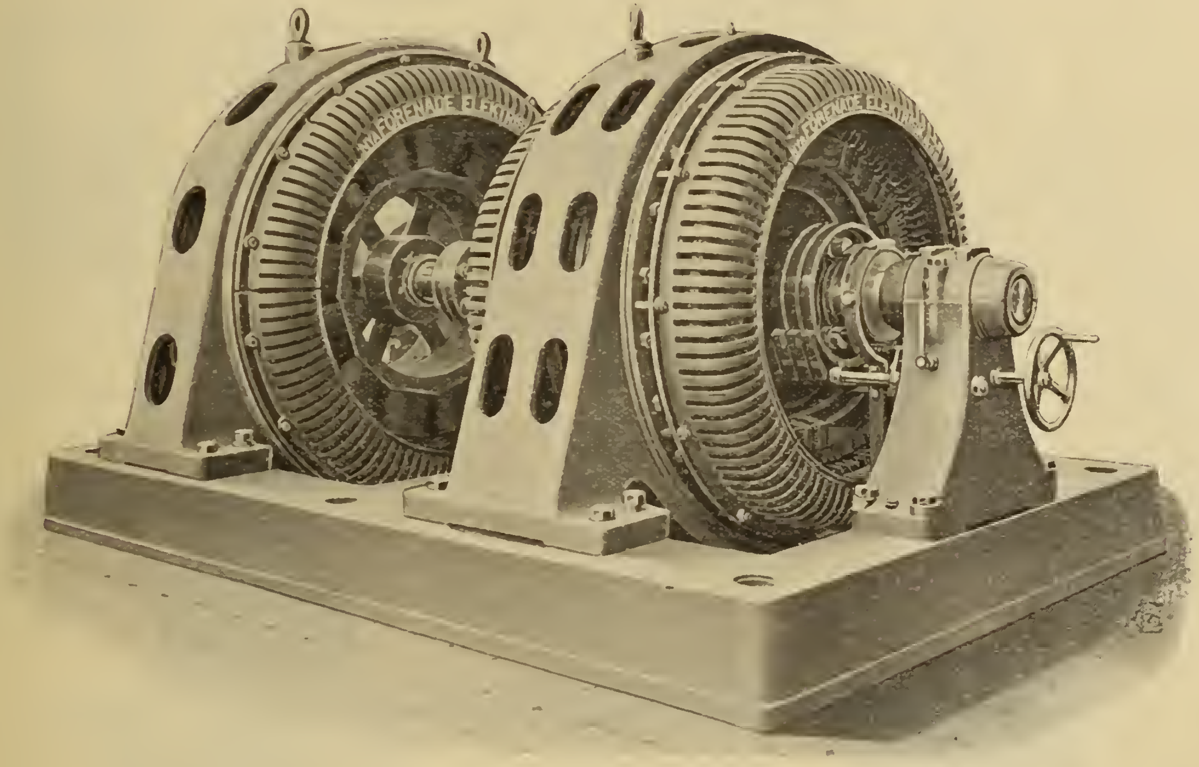

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LAMP GUARD
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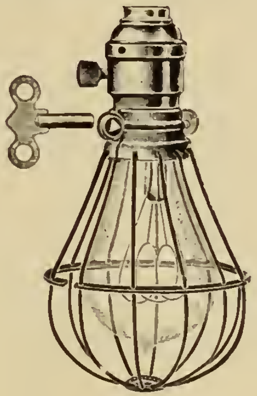

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Electric Circuit Theory and Calculations by W. Perren Maycock, M. I. E. E., published by Whittaker & Co., 1913, (Just out), Price $1.00.

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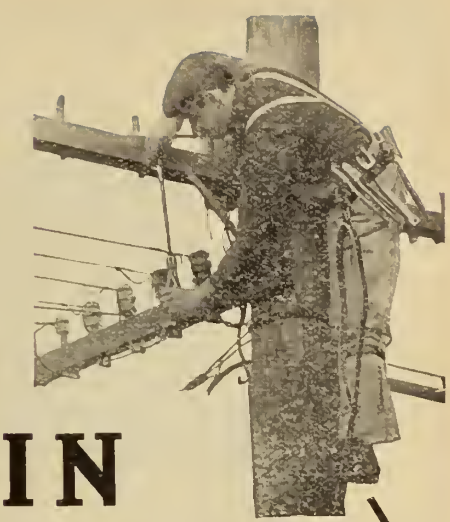

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because he knows that he can trust his life and his job to "KLEIN TOOLS." He's not always so sure about other tools. It isn't a question of cost with the lineman. It's trustworthy equipment he wants and must have. That's why he says "KLEIN" when he asks for tools. Klein Tools cost a little more than the other kind, but there's a good reason for it. There's a profitable hint in this for dealers. Write for our display sign, hang it out, and watch your business increase.

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The contractor profits by installing them in residences, hotels, hospitals and business buildings.

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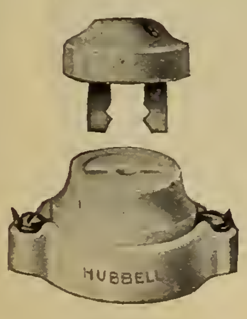

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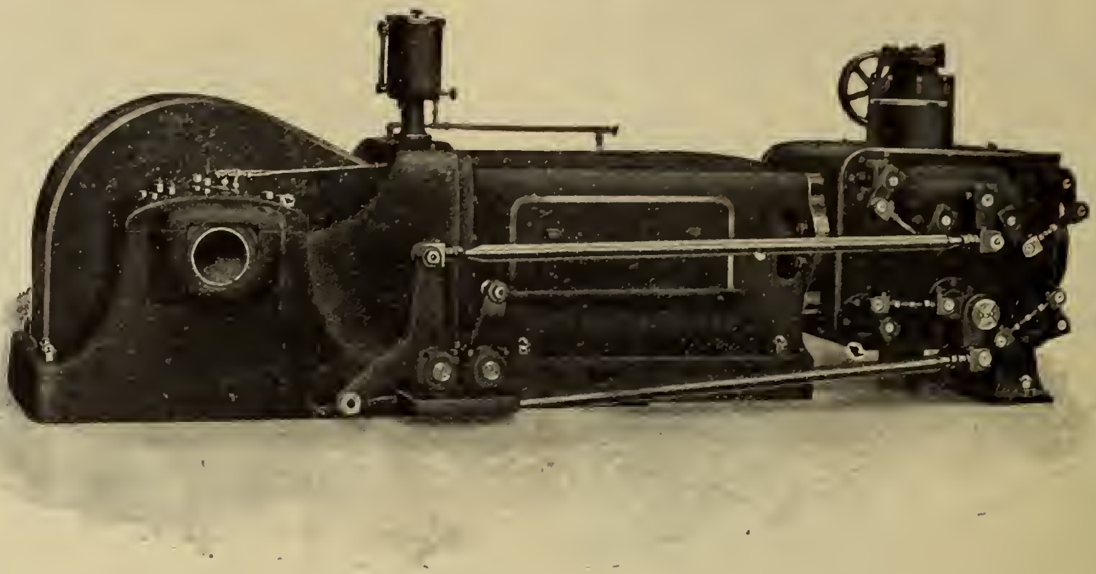

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you don't have to sacrifice fuel saving for high speed. You don't have to get a slide valve engine for simplicity, or a vertical engine to save floor space. This engine combines Corliss saving with high speed and simplicity. The valve gear has no springs, no latches, no cams, no disengaging parts. Multiported Corliss valves permit small clearances and use the steam almost perfectly.

Both single-cylinder and compound.

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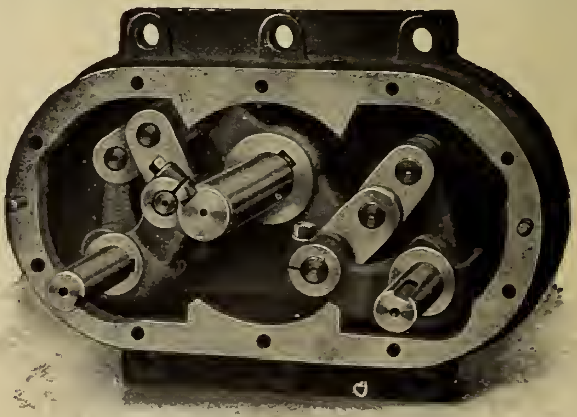

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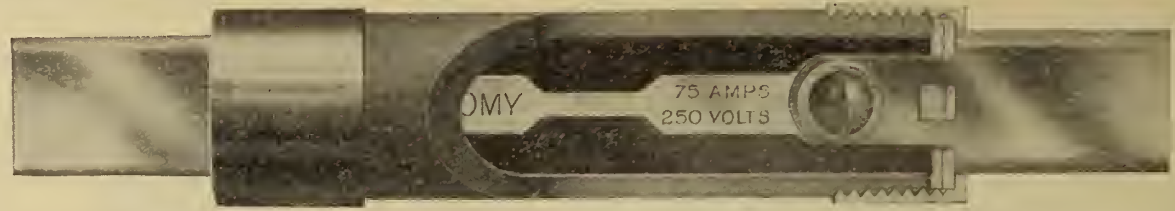

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They use Economy Renewable Fuses for these reasons:

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Good Material in the Hands of Good Workmen

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Vol. 23 Toronto, January 15, 1914 No. 2

General Review of Progress

In this issue we print our annual review of electrical developments, along both engineering and commercial lines, for the past twelve months. It can not be claimed that this report covers developments except in a general way, but it is yet sufficiently detailed to show that the industry is making rapid strides in refinements of manufacture and generality of application. Very marked advances have been made in railway work, in illumination and in electric vehicles, the latter of which, for many classes of heavy work, are now recognized as being superior to either horse-drawn or gasoline vehicles. The introduction of 2400 volt equipment into trunk line work gives promise of an early and more general utilization of electricity by our big railways and the half-watt nitrogen filled incandescent lamp forces us to readjust our ideas of illumination possibilities. In electric heating we seem to have almost reached the point where we can compete, even in operating costs, with gas. This is especially true of electric cooking, where, considering also the other advantages, we may confidently look for a very rapid expansion during the next year. The commercial possibilities in almost every line of electrical application are now better recognized and to expansion in this direction there are no bounds in sight.

The Public Utilities Commission

The possibilities of a public utilities commission in adjusting unsatisfactory relationships between a municipality and a company have recently been satisfactorily demonstrated in Digby, N.S., where past conditions have been such that while the customers have felt the service expensive and unequal to the requirements, the company at the same time have been unable to realize sufficient returns on the capital expenditure to justify them in making any improvements. In adjusting the matters at issue the commission has pointed out that it is quite as unreasonable to expect a company to continue in business except at a reasonable profit as to expect consumers to be satisfied with a poor service, and in demanding a more extended service for the citizens of Digby they at the same time found the company justified in increasing their rates by a considerable amount.

The conditions in Digby seem to have become unusually unsatisfactory. Nearly all customers were on a flat rate chiefly on account of the fact that they were exceedingly small users of electric current. It is said that economy on the part of the consumers was carried to such a degree that over 20 per cent. of the flat rate light users had only one lamp installed, which, of course, was allowed to burn all the time. The final adjustment goes to show that this commission is not prejudiced in favor of municipalities as against private companies, and that their first consideration is improvement of the service, which they accomplish by distributing the obligations as judiciously as possible from the evidence submitted. This is shown by the following decision in this particular case. (1) that all service should be metered; (2) that the rate should be 18c per kw.h. (instead of 12½c as formerly) with discounts up to 20 per cent. depending upon the amount of the monthly bill, with a minimum charge of $1.15 per month; (3) that the rate for 40-watt tungsten lamps for street lighting should be $13.75 per annum. The company on their part must extend the night service to 1 a.m., and during the tourist months, that is, from June 15 to September 15, must give an all-night service; from October till March morning service from 6 a.m. to sunrise must also be given.

Hydro in Port Arthur

The municipality of Port Arthur, who are supplied with electric energy from the Kaministiquia Power Company, through the Hydro-electric Power Commission of Ontario and so are considered by the Commission as subject to the same rules and regulations as govern other municipalities in Ontario served by them, are raising strenuous objections through certain members of their council to what they term interference on the part of the Ontario Commission. The municipality of Port Arthur is at present installing some new equipment in connection with which they are considering the issue of debentures. The Commission state that this is in opposition to the act which requires that extensions shall be made out of surplus earnings, where these exist, and the Port Arthur surplus at the present time is of ample proportion to take care of this expenditure. Another bone of contention is the appointment of a board of commissioners of three which is required by the act, whereas the light and power department in Port Arthur is controlled by a single commissioner.

It is claimed by certain members of the council that Port Arthur has special legislation which overrides anything in the Hydro Commission Act in these two matters, and the present attitude of the council appears to be to fight the issue. It is hoped, however, that a further consideration of the matter will result in the Commission's recommendations being found acceptable to Port Arthur since in an enterprise of the size and importance of the municipal power movement in Ontario it is important that the municipalities stand together in upholding a system which is found beneficial to the greatest number. It may be that in the case of Port Arthur the enforcement of the Hydro rules will work a certain amount of hardship, but it is open to question whether the attitude taken by one of the prominent aldermen, that the surplus in the electric department should be used to offset deficits in other departments, is tenable. If each municipality were operating entirely independently of every other municipality in Ontario, a system to link together the different public utilities in any particular town might well be feasible, but when the electrical department in Port Arthur is only one small link in a big municipal chain it does seem very necessary that that town should conform to the same requirements as other municipalities. This same tendency towards independent action has been noticeable in one or two other cases, but the wisdom of a united support seems to have been pretty generally recognized in the past and, we have no doubt, will be in the present instance. The Commission's hand will be weakened just in proportion as any municipality places obstructions in the way of the harmonious operation of their general plan of power distribution. The success of this municipal scheme may now be considered as more than assured but its highest success will only be achieved by united and unselfish co-operation on the part of the different municipalities being served.

An Unusual Situation

An unusual situation has developed in Morrisburg, Ont., where the municipality formerly owned a hydro-electric plant which is now being used, through the Hydro-electric Power Commission of Ontario, to supply light and power to a number of other villages and towns in the vicinity. The town of Morrisburg apparently resent the "export" of their power and are taking legal steps to recover possession of the plant.

The difficulty evidently arises from the ambiguous wording of an agreement between a Mr. Sharkey and the municipality, by which the former was given a long term lease of the plant with power to assign it to other parties on the written consent of the town council. This consent was given in 1912 and the lease was taken up by The Rapids Power Company. It is claimed by the municipality that the intent of the agreement was that the power should be used within the municipality, though this is not expressly stated, and that the sale of power to the Ontario Hydro Commission for use outside the municipality of Morrisburg is in opposition to the intention of the original agreement. Steps are therefore being taken to annul the contract between Mr. Sharkey and The Rapids Power Company.

The Ontario Hydro Commission are said to be making use of the Morrisburg plant only pending the completion of a generating system at Waddington, N.Y., from which point they will then obtain power. Delay on this work, however, is causing the citizens of Morrisburg some uneasiness as they foresee a possible local shortage of power in case no other source of supply is accessible in the near future. The stand taken by the late council is therefore, that while the present agreement must be cancelled, they will allow the commission a reasonable time to get power from Waddington or elsewhere, say two years, on condition that the control of the local plant revert to the municipality at that time.

Rates in Brantford

The light and power rates to be given in the city of Brantford, Ont., where Niagara Falls power will be available early in the year, have been definitely settled. Up to the present time this city has been served by a subsidiary of the Dominion Power & Transmission Company who generate and transmit from DeCew Falls near St. Catharines. The private company will continue to do business in Brantford, and, it is understood, will meet the figures of the municipal system. The new rates are as follows:—

Domestic Lighting

Service charge—4c per month per 100 sq. ft. of floor space plus a consumption charge of 3c per kw.h.

Commercial Lighting

Consumption charge—6c per kw.h. for first 30 hours' use of installed capacity; 3c per kw.h. for the next 70 hours' use of installed capacity; .15c per kw.h. for all additional consumption.

Commercial Power

Service charge—$1.00 per month per horse power of connected load or maximum demand plus a consumption charge of 1.9c per kw.h. for the first 50 hours' monthly use of connected load or maximum demand; 1.3c per kw.h. for next 50 hours' monthly use of connected load or maximum demand; and .15c per kw.h. for all additional consumption. Commercial power rates are subject to the following class discounts.

Class "A"—24 hours unrestricted use—No class discount

Class "B"—24 hour restricted use—10 per cent. discount.

Class "C"—10 hour unrestricted use—10 per cent discount.

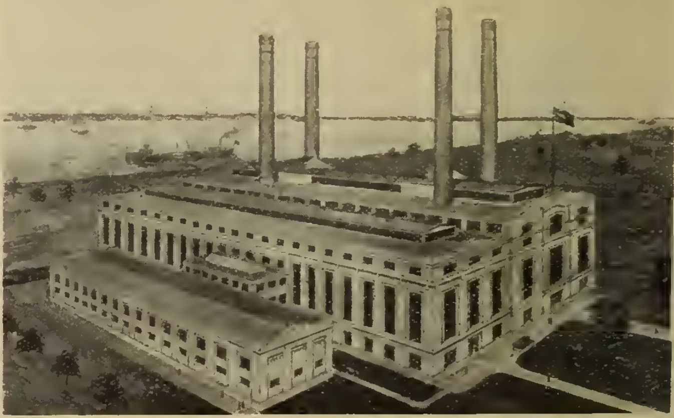
Class "D"—10 hour restricted use—33 1-3 per cent. discount.

All bills for power or light are subject to a discount of 10 per cent. for prompt payment. The restricted hours referred to are as follows:—

October 15th to October 31st—5.30 p.m. to 6.30 p.m.
November 1st to November 30th—5.00 p.m. to 6.30 p.m.
December 1st to January 15th—4.30 p.m. to 6.30 p.m.
January 16th to February 15th—5.00 p.m. to 6.30 p.m.
February 16th to March 1st—5.30 p.m. to 6.30 p.m.

Dominion P. & T. Company's New Steam Plant

The accompanying photo is an architect's drawing of the building which will house the Dominion Power & Transmission Company's immense auxiliary steam turbine plant at Hamilton, Ont. The photo shows the boiler room, turbine room, offices and transformer house. The plant is designed for six 10,000 kw. steam turbo-generating units—the turbines to operate at 200 pounds pressure 200 degrees superheat. The auxiliaries will be mostly steam driven except the exciters, which will be motor driven, although there will be one or two steam driven exciters. Surface condensers will be used as will also turbine driven air hot-well pump, circulating pump and boiler feed pump. The feed heater will be of the open type. The boiler plant will consist ultimately of 14 units each equipped with superheaters and under feed stokers. Definite plans for the interior arrangement are not yet quite completed.



Building to house the large steam auxiliary plant to be built in Hamilton by the Dominion Power and Transmission Co.

B. C. E. R. Co's. Electrical Activities

The big Coquitlam dam completed—New steel transmission tower lines—Best engineering results under most adverse conditions.

Starting operations at sea-level and working to and over an elevation of 2,000 feet and then back again to sea level within the short distance of seven miles is a condition not often encountered in the building of transmission lines. Such, however, was the case in connection with the construction of the new transmission line just completed for the Vancouver Power Company, a subsidiary of the British Columbia Electric Railway Company. This company has heretofore been operating at 34,000 volts transmitted over wooden pole lines, but with the additional installation of 42,000 h.p. at No. 2 power house, situated below Lake Buntzen on the North Arm of Burrard Inlet, it was decided to increase the line voltage to 60,000 volts and utilize steel instead of wooden towers for transmission purposes, wherever possible. The section of steel tower line just erected is seven miles in length, extending from No. 2 power house to Barnet crossing, the point at which the main transmission lines are strung across Burrard Inlet en route to Vancouver. The company's right-of-way between its main generating stations and Barnet is 100 feet in width and formerly carried two wooden pole lines of two circuits each, the pole lines each running twenty-five feet from the centre line. It was originally intended to construct the new tower line on the centre line, but this plan was later abandoned as impracticable on the ground that the angles would be too great for safety. The line as finally built crosses the old lines at several points, while at others it is directly over them, this form of construction necessitating a great deal of very close work, both in tower erection as well as in the stringing of cables. The foundations of all towers are of concrete. Tie rods were first grouted into the solid rock, forms and anchor bolts placed, and concrete poured, before any of the tower material had arrived from the factory. The towers stand 62 feet 6 inches over all from foundation level, with the lower wire strung at approximately 40 feet 6 inches from the ground. One 3/8 inch steel ground wire is carried at the apex of the towers. Ths distance between conductors is seven feet, these consisting of two 3-phase circuits No. 000, semi-hard drawn, seven strand, hemp core copper cables. Standard O.B. suspension insulators and hardware are used throughout. There are sixty-three standard towers and two special towers altogether, one of the latter being located at No. 2 power house, and weighing approximately five tons, while the other will be built for the Barnet crossing. The tower at Barnet will not be erected until next spring, the existing crossing facilities being utilized in the meantime.

Before proceeding to give a detailed account of the manner of erecting the towers, it might be as well to mention that although the actual distance from No. 2 power house, at sea level, to the level of Lake Buntzen is only half a mile, yet the land between these points rises to an elevation of 500 feet. The new transmission line follows the shore of Lake Buntzen for a distance of three miles, at some points being only a few feet above lake level, while at others it is constructed at least 500 feet above the level of the water, this being due to the indented nature of the lake shore, crags and bluffs of great height occurring at frequent intervals. After leaving the southerly end of the lake, the line passes over a mountain known as the Summit, which has an elevation of 2,000 feet above sea level. From here it drops down to the North Arm side of the mountain, and in the course of its windings towards the Barnet crossing, passes Deer Lake. This body of water stands at a height of apapproximately 200 feet above sea level and is about three-quarters of a mile in length. Fig. 1 shows the steel templet, in the form of a cross, used for the placing of anchor bolts in the concrete foundations for the steel towers. To the right in the picture will be noticed a pack horse loaded with South African water bottles in which water was carried for the mixing of concrete through the mountainous country met with on the route. Fig. 2 conveys some idea of the precipitous nature of the rocky bluffs upon which many of the steel towers were erected. The foundation forms as shown stand over 12 feet high, while the anchor bolts for the other two legs of the same tower are embedded in solid rock with no more of a concrete base than was necessary for levelling-off purposes.

The work on practically all of the foundations was rendered extremely difficult for the reason that it was impossible to blast on account of the direct proximity of the wooden pole transmission lines which were handling power for the city of Vancouver.

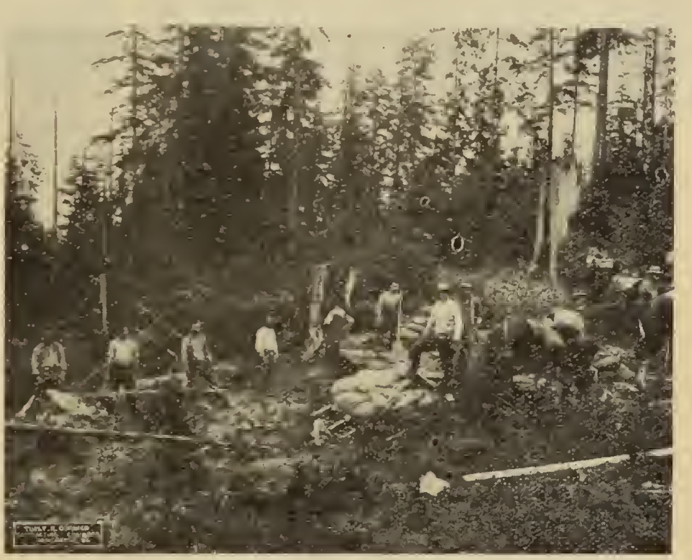


Fig. 1—Showing templet for placing anchor bolts,

The photograph in Fig. 3 shows two steel towers on the shores of Lake Buntzen as well as the two wooden pole lines. The presence of the wooden cross arm and insulator supporting one of the live 34,000 volt cables will be noticed on the tower in the foreground. The background provides a striking illustration of the wild country encountered directly on the route. Reference to this view gives an idea of the proximity of the steel towers to the existing 34,000 volt lines. These towers were erected with the 34,000 volt cables hot. On account of the uneven nature of the ground and the difference in the height of the piers, as well as the presence of the operating high tension lines, it was found necessary to construct every single steel tower in a vertical position, no space being available for assembling on the ground, and erecting afterwards.

Over the Summit the steel tower line runs between the two wooden lines. An aerial cableway or traveller was erected here upon which all material was conveyed to the summit. The use of this equipment was rendered necessary

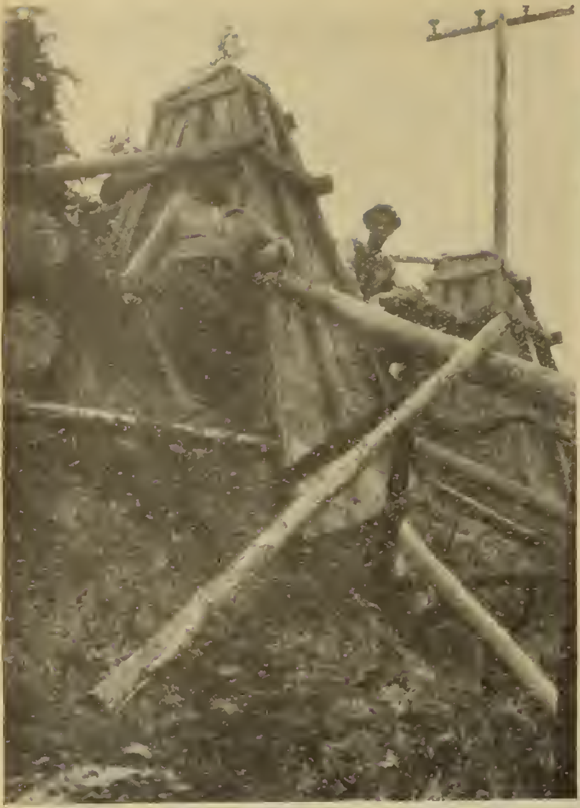


Fig. 2—Tower footings on rocky bluffs.

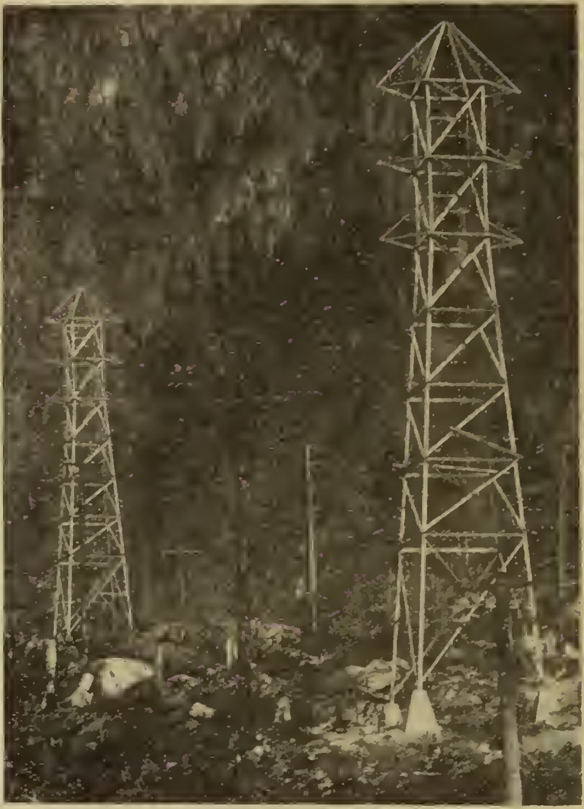


Fig. 3—A section of the steel and two wooden lines.

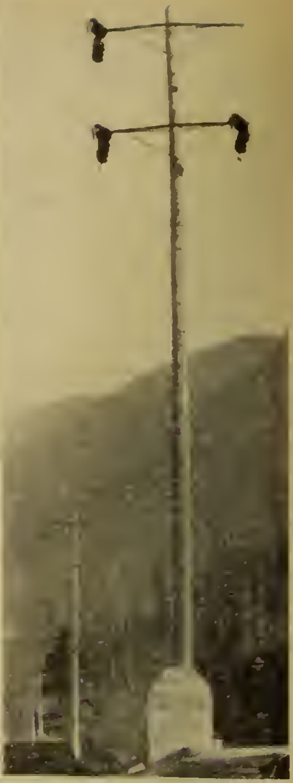


Fig 4—Wooden poles, 60,000 volts.

on account of the fact that loaded pack horses were unable to negotiate the precipitious climb.

In addition to the steel tower line described above the Vancouver Power Company have built and placed in operation a single circuit wooden pole tie-line between its power houses Nos. 1 and 2, a distance of approximately 2,300 feet. This line, as will be gathered from Fig. 4, carries one 60,000 volt, three-phase circuit, as well as a ground wire on one end of the upper arm. This wire is used primarily as an equalizer, and secondarily as a ground. It should be mentioned here that the present 60,000 volt cables on this line will be removed in the near future and placed upon a single circuit steel tower line running alongside the present wooden pole line. The latter line will then be used for carrying two 2200 volt circuits as well as the telephone lines between the power houses.

The manner of constructing the base of the pole shown in Fig. 4 merits some explanation. The entire stretch of ground between the power houses is composed of solid rock with a very thin layer of earth above. It was therefore considered more economical in the placing of these poles to drill a 2¼ inch hole into the rock and also a 2-inch hole into the butt of the pole, then grout into the rock a 4-foot length of 2-inch round iron bar, 2 feet of which was in the pole and the other two feet embedded in the rock. Eight holes were then drilled for the same depth into the rock in a circle round the pole with a diameter of 18 inches. In these holes was placed reinforcement consisting of 5/8 inch round iron standing 2 feet 6 inches above the level of the rock. Forms were then built, these standing 3 feet 6 inches square and 5 feet in height, into which concrete was poured.

The greatest difficulty experienced in the construction of the steel tower line was that of transporting material. All of the steel required was carried along the route by the workmen employed on the contract, and the cement, gravel, sand and water for the concrete was packed in on horseback, as many as twenty-five horses being necessary. The different stages of transportation were as follows: Vancouver to the generating stations on the North Arm of Burrard Inlet by scows; generating stations to the level of Lake Buntzen over an inclined railway, thence along the lake on floats hauled by motor launches. From the lake shore onwards all material was carried by the workmen and on horse pack train. Both of the lakes mentioned in the course of this article were utilized not only for the transportation of material, but also for camp locations, in view of the fact that it was impossible to discover a level spot along the entire route of sufficient extent to even assemble a steel tower. Floats were built and boarded over and upon these the tents were erected, Fig. 5, the floats being towed down the lakes by motor launches whenever it was found necessary to move camp. Transportation on the lakes was provided by three power launches, in addition to several row boats.

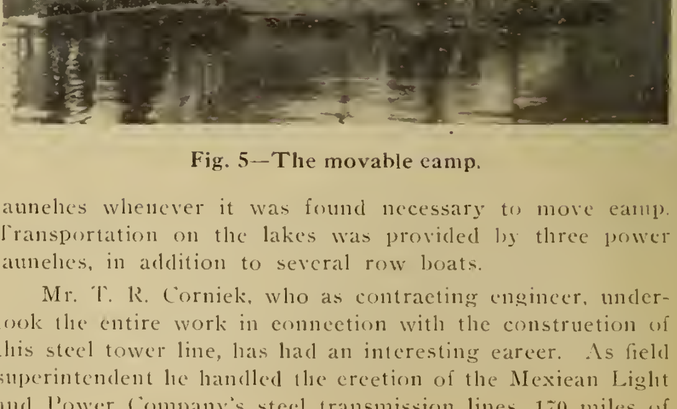


Fig. 5—The movable camp.

Mr. T. R. Cornick, who as contracting engineer, undertook the entire work in connection with the construction of this steel tower line, has had an interesting career. As field superintendent he handled the erection of the Mexican Light and Power Company's steel transmission lines, 170 miles of direct transmission, under Mr. R. F. Hayward, now general manager of the Western Canada Power Company, and later erected all the ground wire masts and cable on the same line as an independent contractor. This work was accomplished within a proximity of 30 inches to 60,000 volt live cables. Coming to Vancouver at the inauguration of the development of the Western Canada Power Company's project at Stave Lake, Mr. Cormick built the entire steel tower high tension system for this company, on independent contract work, between the generating point at Stave Lake and Vancouver, a distance of 32 miles. The contract he has just lately completed forms the first section in the work of rebuilding the Vancouver Power Company's high tension lines between Lake Buntzen and Vancouver, in conjunction with the additional power recently provided at the company's main generating station.

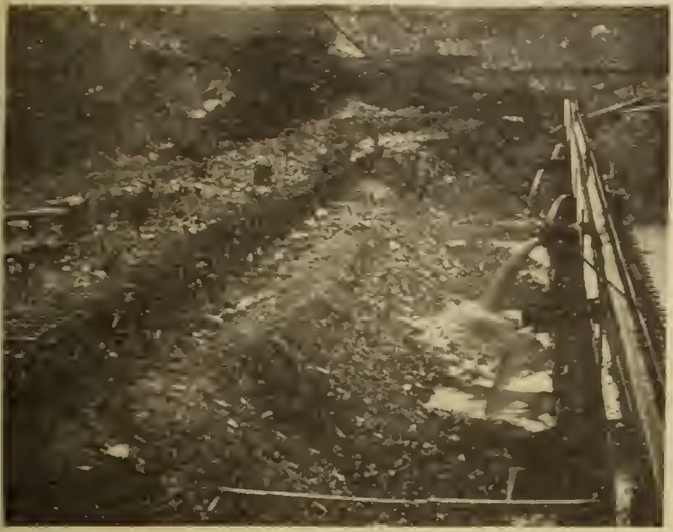


Fig. 6—Rock toe installed, sluicing just beginning. —Lake Coquitlam dam

The Great Dam at Lake Coquitlam

The great dam at the outlet of Lake Coquitlam on which the British Columbia Electric Railway Company have been at work since 1908, and of which a detailed, illustrated progress description was given in the Electrical News of June, 1912, was completed recently and is now impounding an ample water storage supply for the company's two power houses on the north arm of Burrard Inlet where hydraulic and generating units are now turning out 67,500 h.p. of electrical energy, with plans for further development, up to a total output of 85,000 h.p.

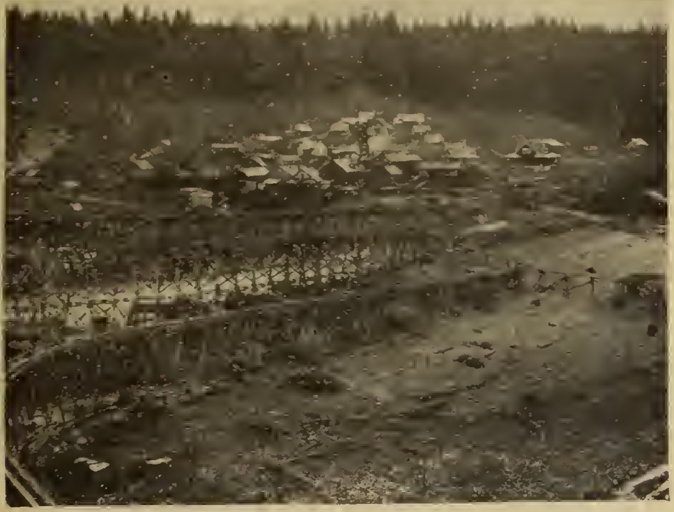


Fig. 7—Up-stream slope during construction. —Lake Coquitlam dam.

The Lake Coquitlam dam has been constructed under the direction of the chief engineer of the B. C. E. R. Co., Mr. G. R. G. Conway. The structure is of the hydraulic fill type, with very heavy rock toes on both the up-stream and down-stream side. The maximum height of the dam is 99 feet and its length along the crest is 850 feet, the width at this point being 40 feet. The width at the base is 650 ft. The down-stream slope of the dam is 2 to 1 at the crest, 3 to 1 at the lower elevation and 4 to 1 from this point to the toe. On the up-stream side the slope is 5 to 1 and 1½ to 1. Both slopes are covered with rip-rap three feet thick. On account of these gradual slopes the total volume of the dam is very large, 530,000 cubic yards of material being employed in its construction. Of this amount 122,600 cubic yards is rock used in the toe walls and riprap. The remainder of the dam is of the hydraulic fill type, this material being almost entirely sluiced from the high hills on either side of the dam through flumes extending across the line of structure.

The work of sluicing was done by a large number of hydraulic monitors. The material is of a fine blue glacial clay, interspersed with boulders. This material when sluiced into the dam makes a perfect fill and the dam as it now stands is believed to be as solid and enduring as any dam on the continent.

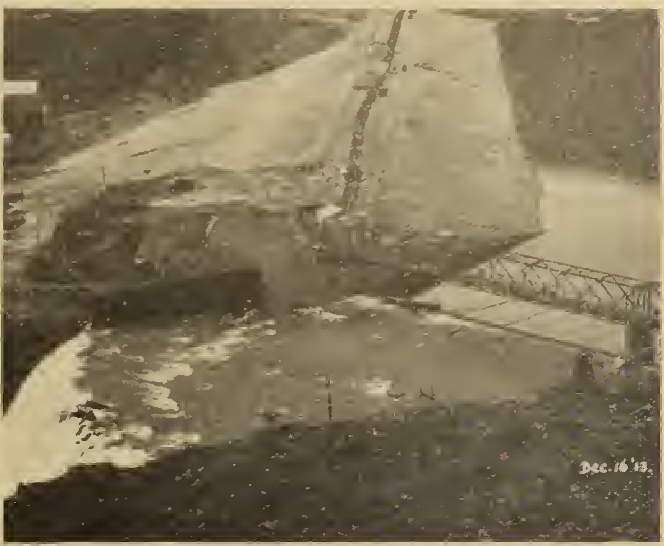


Fig. 8—Completed dam and spillway.— Lake Coquitlam.

During the construction of the dam the flow from the lake was diverted by way of a tunnel driven through the rock just east of the dam. This tunnel is 490 feet in length and has a sectional area of 400 square feet. Now that the dam is completed this tunnel is closed, but provision is made for its use in cases of emergency.

The spillway of the dam is about 15 feet below the crest and has a width of 250 feet. The capacity of the spillway is 12,000 cubic feet per second when the water is 7 feet deep over the sill. The plans for the spillway provide for a carrying capacity of three times the maximum flow from the lake according to records of recent years.

The new dam raises the lake level 60 feet and increases the storage capacity by 162,000 acre feet. The total capacity of the reservoir is now 175,600 acre feet, or 7,560,000,000 cu. ft.

The illustration, Fig. 8, is a general view of the dam, practically completed. The gradual slopes on both the up-stream and down-stream sides make the work appear of much smaller dimensions than is actually the case, as only a comparatively few feet of the total 650-foot width is visible.

Electrical Developments of the Year

A General Review of Progress in the Engineering and Commercial Sides of the Electrical Business during 1913

A review of activities in the manufacture and application of electrical apparatus during the past twelve months reveals no startling innovation but rather a consistent advance of a most general character including generation and all the various uses to which electricity is now put. In a general way, it may be said that progress in generation and transmission is along the line of larger units, higher voltages, and greater efficiency. In application, the uses to which electricity may be put are rapidly increasing and their popularity is becoming very pronounced, this condition being assisted both by the general tendency towards lower rates for electric energy and by the recognition of manufacturers and dealers that the field for small electrical appliances is a very wide and profitable one.

Alternating-Current Generators

The past year has brought forth several notable advances in central station practice one of the most important being improvements in turbo-generator design. Several horizontal turbine units with capacities of 15,000 to 20,000 kw. operating at speeds of 1,500 or 1,800 r.p.m. for 25 and 60-cycle work, have been installed and put into service during the year, and early performances indicate them to be exceedingly successful as regards reliable service and efficient operation. The most notable advance in this line of apparatus is the new design of the so-called "cross-compound" type of turbo-unit for ratings of 30,000 kw. and above. An order for three of these units has quite recently been placed with the manufacturers by the Interborough Rapid Transit Company of New York City.. The "cross-compound" idea is not an entirely new one, as in the very early days of Parsons turbine design, two separate and distinct turbines were mounted on the same shaft with one large generator. Due to improvements in the design of these units, and the difficulty of proper alignment, this design was superseded by one larger horizontal turbine coupled to a single generator. The "cross-compound" idea carries the original scheme out farther and removes any objectionable features such as difficulty of proper alignment, etc., inasmuch as it contemplates two separate turbines driving two entirely separate generators, one generator to be coupled to a high pressure, non-condensing turbine operating at the highest practicable, and consequently the most efficient, speed and the steam from this turbine exhausting directly into a low pressure cylinder operating at a lower and more efficient speed for low pressure steam, this low pressure turbine being direct connected to a second synchronous generator of similar capacity to the first, the leads of both generators being tied permanently together. These generators can be wound for any of the higher voltages considered practical today, such as 11,000 and 13,000 volts. This combination promises to be by far the most efficient unit yet to be designed, since guarantees made show a Rankine cycle efficiency of approximately 75 per cent. We understand that several of the Edison companies have also placed orders for machines of this rating.

Developments in generators to be driven by other types of prime movers, particularly water wheels, have been largely in the nature of increased capacities and refinements in manufacturing processes, enabling the manufacturer to build units even more reliable and efficient than in the past. Notably among these newer machines may be mentioned single vertical type units of capacities in excess of 12,000 kw., and operating at very low speeds, for coupling directly to single runner water wheels. Units ranging in capacity from 12,000 to 17,500 kv.a. have been installed, and are now in operation showing very satisfactory results.

Rotary Converters

While large 60-cycle commutating-pole rotary converters and 25-cycle commutating-pole rotary converters were previously developed to a great extent, they have this year fully demonstrated the claims of the manufacturer on performance by their successful operation. The results obtained prove them to be thoroughly satisfactory both from an operating and economical standpoint. The installation of ten 1500 kw. and two 1000 kw. 60-cycle rotary converters by the Cleveland Railway Company is worthy of mention, as it is the largest 60-cycle rotary converter installation in the world and is giving remarkably satisfactory results.

As in other classes of apparatus, the tendency is to the use of the larger units. Although no larger 25-cycle units have been developed during this year, the largest rotary converters that have been built to date have been completed and installed. Nine of these converters, which are of 2500 kw. capacity each have been purchased by the Aluminum Company of America. The field of the 60-cycle rotary converter has also been extended through the purchase by the Southern Power Company of three 500 kw. rotary converter units, consisting of two machines of 250 kw. capacity each mounted on a single bed plate and arranged for operation in series on 1500 volts direct current.

The Portable Sub-Station

Another development of great importance this year is the "Portable Sub-station." It is designed after careful consideration of all the requirements to be met, special attention being given to the safety of the operator and to simplicity in operation. The portable sub-station has not only been developed within the year, but has demonstrated in actual service that it fully meets requirements demanded for it. In the matter of high-voltage direct-current work, the tendency towards this opinion is shown in the purchase by the Southern Power Company of a portable sub-station for their railway work, the car to include a 500 kw. motor-generator to operate through suitable transformer, also mounted on the car, from either a 2,400 or 44,000-volt circuit.

Motor-Generators

The tendency in motor-generator sets has been more and more towards the use of motors having condenser capacity, involving new designs. There has been however, no radical change in the design of motor-generator sets. The two 3,750 kw., 27-volt, 180 r.p.m. direct current generators, used with turbine and reduction gear, installed the latter part of last year for the Cleveland (Ohio) Electric Illuminating Company are the largest in capacity at 180 r.p.m. that have ever been built. They are not only demonstrating that they are satisfactory, but they are demonstrating the practicability of the turbine-reduction-gear direct-current generator unit.

Transformers

The trend in transformer construction is toward higher capacity units—higher primary voltages and higher reactance obtained in such manner as to provide increased strength against short circuit strains. This reactance protection is a direct sacrifice in the regulation of such transformers but is coming to be generally recognized as a necessity to meet the new conditions imposed by the steadily increasing capacity of generating stations. A dozen years ago there were few, if any, stations with sufficient generating capacity to maintain normal impressed voltage with a short circuit on the line. To-day this condition is the rule rather than the exception.

In recognition of these conditions and in addition to the increased protection due to higher reactance designs the leaders in transformer manufacture have adopted improved methods of coil bracing. Straight spacing strips were superseded several years ago by the so-called "wavy spacers" and this has again given place to the "Button" type of spacer, which consists of rows of staggered buttons on the face of sheet pressboard.

This latest method of spacing and bracing shell type coils provides positive bracing for each and every turn at regular intervals of from two to four inches and at the same time gives entire freedom to the circulation of the oil.

During 1913 one Canadian factory has built and shipped twelve 1000 kv.a. oil-cooled transformers, these constituting the largest self-cooled transformers yet manufactured in Canada, and work is well in hand on several 110,000 volt transformers and on two 6,750 kva., three-phase transformers of interest on account respectively of the high voltage and high unit capacity. Of almost as high capacity and actually of larger physical dimensions are three 25-cycle, single-phase, 6000 kv.a., 86,500 volt transformers together with three 5,500 kv.a., 76,000 volt step down transformers for the same transmission company.

In the field of the small transformers there has been a notable increase in the demand for higher voltage distributing transformers. The leading manufacturers are providing in these small high voltage transformers the same high factor of safety in insulation values, which have led to the well known long life characteristics of safety and durability in their standard 2,200 volt transformers.

Insulating testing transformers and their control have been further developed. Transformers giving 500,000 volts from high tension to ground under normal conditions have been put into successful operation.

Extensive increases have been made in high capacity, high voltage transformers for hydro-electric systems, as exemplified by the fourteen (14) 150,000-volt transformers recently installed for the Pacific Light & Power Company. It is interesting to note that for these higher voltage units, there is employed an extension of the already well developed condenser terminal instead of having recourse to some untried scheme. The developments of the existing line seeming to meet the conditions imposed by the higher voltages in an entirely satisfactory manner.

Particularly noticeable has been the continued growth in the use of outdoor transformers. The power transmission companies and railway companies are beginning to realize the importance of the electrification of the small community and the farm. During the year a number of complete outdoor sub-stations consisting of transformers, switching and protective equipment of steel towers have been installed.

A recent order of more than usual interest is one from the Southern Power Company for a portable sub-station for power and lighting. Different from most portable sub-stations, this one contains only transformers with switching and protective equipment. There will be three transformers, each of 1000 kv.a. capacity of the self-cooling type. The high tension voltage will be 100,000 and the transformer will be designed so that it can be used on voltages of 100,000, 44,000 or 13,200. The low tension side will be arranged for 13,200 and 2,300 volts. This portable sub-station will be sent from place to place and used while repairs or extensions are being made at the various sub-stations.

Current Transformers

A new line of current transformer has been developed for use on voltages up to 2,500 volts. These transformers represent a very material improvement over previous transformers in the matter of accuracy, both the phase angle and the ratio error being considerably decreased. The transformers are of very simple construction, consisting of a core built up of E punchings with form wound secondary and primary coils assembled around the center leg. Primary coils are insulated from the secondary coils and from the core by layers of varnished cambric. The test voltage used is four times normal, showing a very liberal factor of safety for the insulation.

Railway Loads Carried by Central Stations

The number of railway companies operating partly or entirely on power purchased from central stations is greatly increasing each year. The 60-cycle rotary converter through its economical and reliable operation makes possible such arrangements with mutual advantage to both the railway company and the power company.

Switchboards

Switchboard design has so developed that now there are several important types of switchboards especially applicable to typical service conditions met in railway work such as,—desk types boards for large generating stations; typical generating systems for city service; typical 600-volt d.c. generating and distributing boards; 1,200, 1,500 and 2,400-volt d.c. for railway service.

In the field of switchboards proper—the changes and innovations during the past year have been relatively small in number. One of the most noticeable features has been the increasing demand for what might be termed "the vertical type of benchboard." The usual type of desk or benchboard while economical in the matter of space—is at the same time relatively expensive to build and install, and access to the small wiring at the under side of the bench is not easy. The photograph herewith, showing switchboard for the Winnipeg Electric Railway Company's Transcona substation, gives a good idea of the new type of board. The mimic buses and connections together with the control switches are mounted on the face of the vertical panels, at a height best suited for operating purposes. Such a board, with its instruments, meters and relays, usually takes up even less space than the old style benchboard, and is at the same time a simpler and hence better switchboard. In the position shown the control switches are as easily operated as when on a bench. This type of board will be used by the Toronto Power Company for their Niagara station—replacing the existing benchboard—and by the B. C. E. Railway Company for the large step-down transformer stations at Sapperton and Hastings.

Of the higher voltages may be mentioned the board for the Piedmont Traction Company, the largest 1500-volt direct-current railway service in existence. All 1500-volt breakers, switches and conductors are placed at the top of the board out of ordinary reach. These switches and breakers are of the remote control type, being operated from a handle mounted on the central panel. All handles are insulated by specially treated wooden rods. Accidental contact with high voltage by attendant when operating board is impossible. These boards control two 750-volt, direct-current generators connected in series in order to deliver 1500-volts which is the trolley voltage of the system. The sub-stations along the line are placed from 15 to 25 miles apart to meet the varying traffic conditions and points of delivery of power by high-tension lines.

Another step forward in the development of high voltage d.c. switchboards has been made through the successful design of 2,400 volt equipment. The 2,400 volt switchboards follow in general along the lines of the well-known 1,200-volt boards. The circuit breakers and disconnecting switches are remote control-mounted, however, separate from and in the rear of the panels, rather than at the top of the panels themselves as in the case of 1,200 volt boards. This change is made mainly to afford additional safety for the operator. The circuit breakers are equipped with carefully designed magnetic blowout arc chutes, and are provided with ample barriers to prevent any possible trouble from the severe arcing to be expected at this voltage. Ammeters are supplied with insulating covers with glass fronts, and all live parts are thoroughly protected so as to make accidental contact very difficult.

Arc Lighting

The illumination of streets at night was formerly considered the only function of lighting units, but in this twentieth century spirit of progressiveness and economic management, the tendency is to make the lighting units so attractive that they enhance the appearance of the landscape by day as well as by night. The status of the magnetite luminous arc lamp is now well established and the phenomenal success of the pendant type, combined with the present demand for a more ornate unit, has resulted in the later development of the ornamental luminous arc lamp. This lamp has the same characteristics and embodies the same principles as the pendant type; in fact, it is the same lamp with the arc placed above the mechanism, only such changes being made as were mechanically necessary. This lamp now permits the use of a pole which lends itself to highly artistic treatment. The single lamp on top of the pole enhances the appearance of the street or boulevard on which it is installed, while at night the effect of high candle-power, with the light softened and diffused by a specially designed globe, is very good. The light is pearl white, of high efficiency, and low intrinsic briliancy. There is an entire absence of glare and shadows.

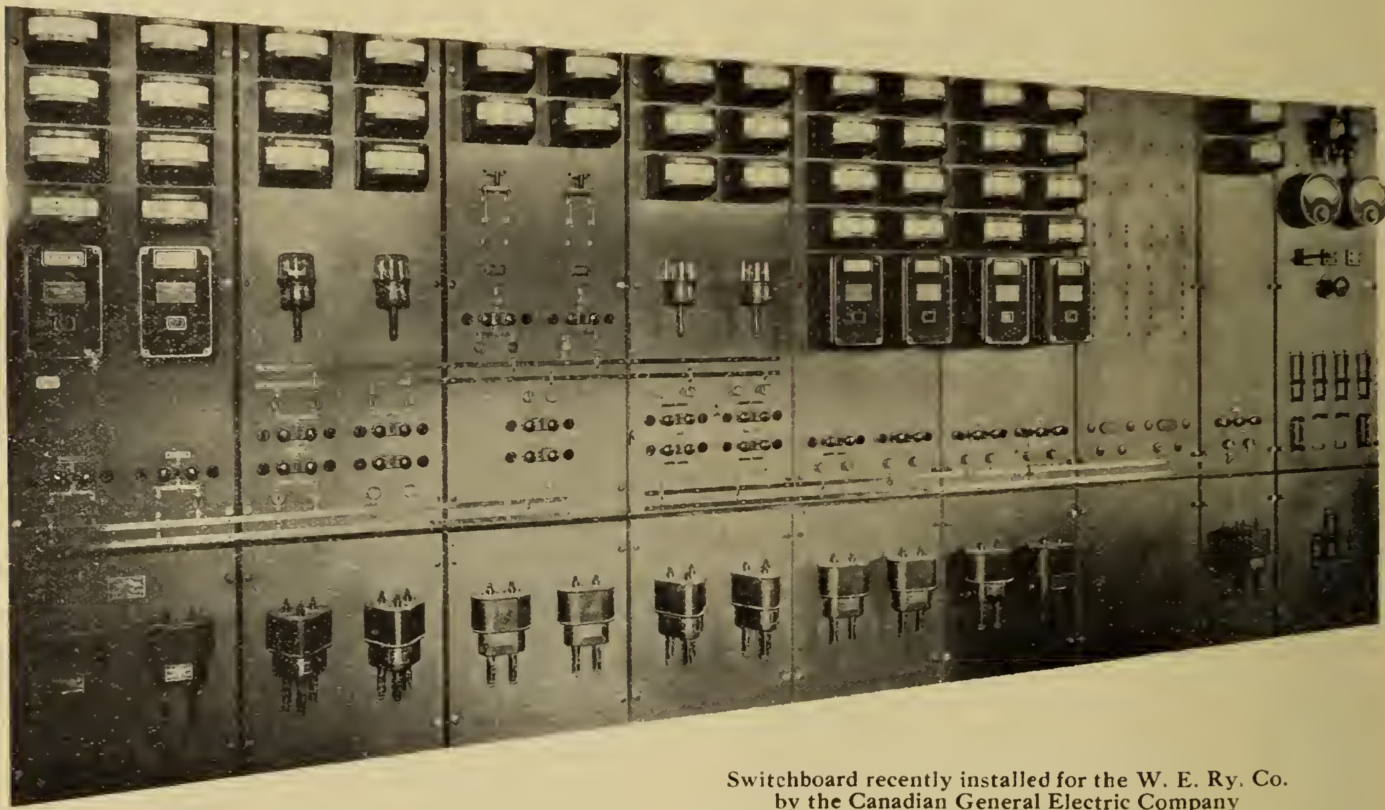
There has also been developed and placed on the market a new line of flame carbon arc lamps adaptable to all commercial circuits. A flaming arc lamp has also been developed which is claimed to operate satisfactorily on 25 cycles and burn 120 hours per trim. The specific efficiency of this latter lamp is 3½ to 4 c.p. per watt according to circuit conditions.

Electric Traction

In the electric traction field the greatest advance has been made along the lines of high voltage direct current operation for the heaviest class of trunk line service. One of the big manufacturing companies has adopted 2,400 volts direct-current for service of this nature, and a few months ago secured a contract from the Canadian Northern Railway for locomotives, motor cars, and sub-station apparatus of 2,400 volts to be used in connection with the tunnel under Mount Royal and the terminals in the City of Montreal. A description of these locomotives appeared in the Electrical News of December 1. To show that there is nothing of an experimental nature about the electrical equipment for this service the following letter from Mr. Gallwey, general manager of the Butte, Anaconda & Pacific Railway, is of the greatest interest. This company operates the equivalent of 90 miles of single track with seventeen 80-ton locomotives with overhead catenary construction at 2,400 volts d.c.

"In reply to your inquiry I would say that on October 1st, 1913, the Butte, Anaconda & Pacific Railway established regular electric passenger service between Butte and Anaconda. For approximately four months previous to this the freight service between East Anaconda yards and the smelter had been handled electrically. During this period electric locomotives have made approximately 55,000 miles and have delivered to the smelter about 1,500,000 tons of ore. Since starting the electric service there has been no failure of any of the electric apparatus and no delay in any way attributable to electric operation."

A direct result of the successful operation of 1,200, 1,500 and 2,400 volts d.c. equipment for railway work has been the changing over of a number of railway systems from single-phase to high voltage d.c. operation. In addition to the two above mentioned 2,400 volt systems, the Michigan United



Switchboard recently installed for the W. E. Ry. Co.
by the Canadian General Electric Company

Traction Company, of Jackson, Mich., are now preparing to place twenty 2,400 volt electric locomotives on their lines, and the C. P. R. are so equipping part of their Pacific system.

Electric Vehicles

The principal increase in the demand for electric vehicle equipment has been in connection with trucks and delivery wagons. In New York city 40 per cent. of the power vehicles devoted to business are of the electric type and electric trucks are now employed in 76 different kinds of business. The electric truck has also been used to solve the transportation problem, as for example in New York, where 120 battery cars, each with a seating capacity of 28 persons, are now operating.

The design of the electric truck and the efficiency of the storage battery has now reached a very reasonable degree of perfection and the prejudice against the earlier and less satisfactory equipment has been almost overcome. Merchants are realizing that a greater amount of ground can be covered at smaller overhead expense and central stations are recognizing also that this form of load is a highly satisfactory one.

Considerable advance has been made in the system of charging, although this remains one of the obstacles in the way of rapid increase in the use of electrics, especially of the passenger type. There is now becoming established, however, in the larger places, a more satisfactory system of charging stations and good results are expected from a new type of motor-generator of small capacity, recently placed on the market. A rapid expansion in the electric vehicle business may confidently be looked for during the next year.

Small Motors

There is a continual increase in the use of small motor-driven machines for the office, home and store. This is due to the distinct advantage of a motor-driven machine over a hand-driven machine. Central stations have been very active in promoting the sales of these machines as have dealers and jobbers. The demand over the country has been fairly uniform. The method of driving washing machines, for example, by motors has been greatly simplified and the mechanism used on later types of machines has been such that the machine and driving mechanism is fully protected from interference by the operator and in turn fully protects the operator from injury from moving parts.

There has been a great increase in the demands for motor-driven office machinery such as adding machines, mailing machines, addressing machines, combined computing and typewriting machines. This has been due not only to the perfection of the motor-driven machines, but also to the fact that there is an increasing tendency to analyze the cost of operating offices. The remarkable increase in the quantity of mail matter transmitted from point to point throughout the country, in the use of circular letters and in the distribution of all kinds of printed matter, has increased the demand for this type of machinery and has made motor-driven office machinery more popular.

The demand for motor-driven air pumps has increased to a remarkable degree, these being principally used in connection with garages for producing compressed air for blowing up automobile tires.

Water pumps have been used in the home, apartment and hotel. There is a particular demand for these in suburban districts and this is often necessitated by the condition that in several districts throughout the country hard water is plentiful but there is a small supply of soft water. Private supplies of soft water must be obtained and rain water is usually collected and distributed throughout the home and out-buildings by means of an electric pump which pumps the water into a central tank, or else by some use of an air pump and pressure system.

A great number of popular amusements such as moving picture shows, entertainments, lectures, etc., is increasing the frequency in which masses of people are gathered together indoors. This fact, connected with the realization of the benefits of good ventilation, and the injurious effect of poor ventilation has brought about an almost universal use of motor-driven ventilating fans and blowers.

The vacuum cleaners of various types continue to grow in popularity. The stationary type has now become a necessity in connection with public buildings and is considered just as carefully as a heating or ventilating system. The very small high-speed fan type vacuum cleaners have become more popular in the smaller homes, although the larger homes are often installing stationary types. The heavy portable type is used only to a limited extent in connection with the home but is largely used in public buildings where an attendant is available to move it from floor to floor during the process of cleaning.

Electric Welding

The use of electric welding has been greatly increased through the supply of the proper equipment by the manufacturers. The welding of metals by the electric arc may be briefly defined as the fusing together of two metals, without pressure, allowing them to melt, mix, unite and then cool. For heavy cutting and for the repair of castings which show defects of blow-holes and imperfect formation, and for general work, the metal to be welded is made one terminal of the direct-current circuit, and a carbon electrode the other. Upon placing the carbon electrode in contact with the metal and then simply withdrawing the same, an arc is established between the two. By this means, which produces the hottest flame known, having a temperature between 3,500 and 4,000 deg. C., the metal may be either directly welded, melted away, moulded into a different shape or fused to another piece of metal as desired. With this process the current ranges from 180 to 1000 amps., depending upon the class of work being done, 250 to 350 amps. being the average value for ordinary work. For lighter and smaller repair work the metal to be welded forms one terminal of a direct current machine while the other terminal is formed by a metal pencil instead of the carbon electrode. This pencil is usually 3-16 to ⅜ inches in diameter coated with a suitable flux, and the operator holds it by means of a pair of plyers or tongs connected to the terminal. The arc is drawn as described above, and with a ¼-inch carbon, is approximately 3-16-inch long taking from 150 to 180 amperes. This latter process is used extensively in railway shops for flue welding, boiler and fire box repair, also in machine shops for repairing steel castings, etc.

A 75-volt commutating pole d.c. generator driven by a motor is generally used. Several sizes of motor-generator sets, especially adapted for arc welding work are now on the market. The apparatus is especially useful in repairing fire boxes of steam locomotives, repairing engine frames and for general repair work, as found in machine shops.

Magnet Switches and Control

The past year has seen the introduction and successful operation of a line of magnet control switches for industrial service that bids fair to very greatly enhance the application of electric motors to severest industrial requirements. Their design was preceded by long and careful study of the needs of this service and by extensive experimental work. One particular point of this new type of control is that the control systems have been very much simplified, due to the use of a specially designed series type of contactor. It has recently been demonstrated that magnetic controllers are especially suitable for hoist motion of cranes, especially where controllers of large capacity are used. One special feature, now included in magnetic controllers in particular is dynamic braking which is very useful in the lowering motion. This feature in the controller permits of a much simpler mechanical construction of the crane, as a mechanical brake is not required. Elimination of this particular feature (mechanical brake) is quite an advantage to the user, as it is a rather complicated piece of apparatus and requires considerable attention and as a rule, is the source of considerable trouble. The steel mills of to-day have practically adopted the magnetic control for the majority of the motor applications, where the service is of intermittent character. There has recently been developed a very simple system of control for blast furnace skip hoists. Several of these controllers are in operation.

Large Motors for Steel Mills

One of the large manufacturing companies secured an order from the Bethlehem Steel Company about the middle of last year, which is rather unique in character. At the present time, all of the reversing blooming mills in the United States are driven by steam engines. The Bethlehem Steel Company ordered a reversing motor equipment to drive their 35-in. blooming mill. Although there are two reversing blooming mill equipments operating in Canada, the equipment for the Bethlehem Steel Company will be the only one in the United States and, it is said, will be much larger than the Canadian equipments. It is believed that the results obtained at the Bethlehem Works will do much to stimulate the interest of the steel companies in equipments of this kind. It is a radical departure from steam engine practice and the steel companies have been slow to take up with the motor idea for reversing work, although the above manufacturing company alone have approximately 100,000 h.p. in motor equipments driving non-reversing mills.

Steel Frame Induction Motors

For a long time the squirrel-cage induction motor has been considered nearly the acme of perfection. The last year, however, has seen a further refinement of this motor in the production of a new steel frame squirrel-cage induction motor, designed for constant speed, continuous service, 20 to 200 horse-power, 110 to 2,200 volts. This new development represents what is claimed to be the most satisfactory induction motor ever produced commercially. Special features of its construction are: steel is largely used throughout, not only providing great strength, but reduces weight to a minimum; rotors practically indestructible; bearings have liberal areas; non-leaking and dust proof; construction simple and number of parts small and interchangeable; efficiency, power-factor, and overload capacity are unusually high.

Slip-ring A.C. Motors

A new motor of the above type embodying many advanced features of construction has also been brought out within the year. It is especially designed for operating small cranes and hoists and for other severe intermittent varying-speed reversing service. It is built in capacities of 2 and 3 h.p. 3-phase, 220 and 440-volt, 60-cycles, 6 poles. The frame is built of rolled steel. The bearings have liberal areas and are non-leaking and protected fram dust. Special attention has been given to ease of dismantling, so that in case of accident repairs can be readily made.

The torque that can be developed is the maximum obtainable for the rating. The speeds are comparatively low. The stator is of the frameless type. The core laminations are riveted together under high pressure between pressed steel rings called end shields. A one-piece pressed-steel foot is rigidly attached to the end shields. Each bracket has on its face a machined flange which fits inside the frame and insures rigid support and perfect centering of the bearings. The rotor is comparatively long and of small diameter, thus reducing the fly-wheel effect. This feature, together with the perfect balance and secure attachment of the windings, make these rotors especially adapted for frequent starting, stopping and reversing.

Electricity in Mines

The past year has seen a remarkable increase in the amount of power contracted for by central stations in the coal mining field, combined with which has made an increased demand for synchronous motor-generator sets as against rotary converters, by reason of the over compounding feature which is necessary in order to take care of the large line drop, experienced in coal mine distribution. The purchase of power by coal operators is looked upon more favorably than ever before.

A great advance has been made in the application of heavy electric hoisting from both coal and metal mines, the most notable being the recent order placed by the North Butte Mining Company of Butte, Mont., which is the largest electric hoist installation in the United States, up to the present time.

The introduction of the self-starting motor for direct current up to 20 h.p. has met with great favor, as it eliminates the complication of automatic starters, or the necessity of starting manually a pump or fan inside the mine every time the circuit breaker opens due to overload or other cauess.

The general demand for the barsteel locomotive frame construction with the use of commutating pole motors has shown that this latest development in locomotive construction has been in the right direction, as has also been demonstrated in the use of bronze motor bearings with oil waste packed housings in line with the most modern street railway practice.

The increasing sales of motor-driven compressors, particularly in metal mines, has demonstrated the superiority of this type of machine where power is available either from central public service stations or from privately operated central energy plants, where standby losses are reduced to a minimum. One of the principal advantages is the ease of locating the compressor stations nearer the application of the air to the work, thus reducing the transmission losses in .the air system.

Pole Line Equipments

We note, during the past year, an increasing tendency toward the use of the highest grade of material obtainable. More and more companies and municipalities are calling for braces, bolts, rods, clamps, etc., made in accordance with standard specifications. The most remarkable feature of the year's developments, however, is the rapidity with which steel is replacing wood. Although most apparent in high voltage lines, this change is affecting all overhead constructions and is a move in the right direction since it gives the advantages of safety and freedom from expensive renewal at a very slight increase in first cost, and, when maintenance charges are considered, represents a considerable saving.

The majority of new lines of less than 60,000 volts are limited to a single circuit, the practice being to follow separate route when an additional circuit is necessary. This arrangement greatly favors the use of a steel fixture, combining arms, braces, and in the lower voltages, pins and ground wire supports. The "Bo-Arrow" arm, made of angle steel in triangular wire spacings of 36 in. to 72 in., was introduced last spring and met with favor over 10,000 arms being placed in service during the year. For a 24 in. triangular wire spacing the "Hi-Ten" fixtures of steel pipe received an equally gratifying reception. In brief, these fixtures give permanence and safety to construction work at a cost which is actually less than that of a good grade of wood construction, due in part to the lower cost of installation on poles. There is a noticeable tendency in recent practice to increase the wire spacing for a given voltage, probably on account of a desire to raise the voltage at some future time.

About ninety per cent. of the lines recently built are equipped with overhead ground wires, and many companies are installing such protection on all their older lines, as its efficacy seems to have been proven, assuming the wire to be properly clamped to a well designed bayonet. In some quarters there is an objection to the use of grounded metal arms, which is met by tying the ground wire on a smaller insulator screwed on a steel spring thread on the end of the bayonet. When desired, the ground wire is used as a neutral of 4-wire, 3-phase system.

The clamp pin is replacing the wooden and malleable types for all kinds of high and low tension service with wooden arms, because its use develops the full strength of the arm instead of half the strength, as in the old type of pin. There are no holes to allow water to reach the heart of the arm and cause decay and splitting, and the saving in maintenance charges is considerable. In one large system clamp pins are used exclusively, and on this account the fir cross arms used are guaranteed by the supplier to last 20 years.

The present day policy of supplying power to all sizes of consumers has produced some problems in the proper supporting of transformers on poles, and a good solution seems to be to use angle and channel steel platforms for one or more poles, depending on the size and number of units required.

Oil Switches and Breakers

Numerous improvements have been made in medium capacity oil switches for voltages up to 15,000 volts. The new lines are provided with greater spacings between poles, larger air and oil space, and improved insulation between live parts and the frame (ground). The most distinct improvement, however, lies in the use of "clamped in" insulators. This is a very strong and simple construction which obviates the necessity for the use of cement or babbitt for fastening the bushings to the frame, and also allows the bushings to be readily removed when necessary. The clamping surfaces are perfectly trued and drilled, and thus the replacing of parts is accomplished quickly and perfect alignment is insured. The bushings themselves are one piece porcelains—and extend below the oil level—thus increasing the insulation qualities of the switch.

Oil type breakers have been built for operation on voltages as high as 165,000. The details of these breakers closely resemble those of standard lower voltage breakers. Reactance type breakers have been developed to cover voltages as high as 110,000. They have been developed along the lines of two forms—one arranged for floor mounting, voltages ranging from 25,000 to 165,000; the other arranged for cell mounting, for voltages up to 22,000. Both forms are nominally rated at 200,000 kv.a. ultimate breaking capacity.

The carbon-break type has been extended to cover capacities from 200 to 800 amperes in addition to the capacities of 1,000 to 20,000 amperes as developed in the year 1912.

Condensers

Condenser practice, both jet and surface has received tremenduous stimulus by the hydraulic air pump, particularly the Westinghouse-Leblanc air pump, and is moving forward with very rapid strides. In surface condensers of recent construction the heat transfer formerly considered the maximum obtainable has been easily doubled.

Prime Movers

Steam engines of the Corliss type for electric light plants, office buildings, hotels and smaller generating stations are now being installed to operate at speeds from 150 to 250 r.p.m., according to the work, permitting the use of a moderately small sized generator. This makes a complete engine and generating set very compact in floor space and embodying high economy and smooth running. The tendency in water turbines of the smaller units is still in favor of the horizontal shaft type. Normal speed turbines continue to demonstrate their superior working qualities. In Canada the conservation of our water powers is a very live topic and promises to increase in interest as the years go by and the efficiency of the hydro-electric equipment installed will therefore be a matter of extreme importance. We believe our engineers will do well to make a specially careful study of the efficiency of the various types and speeds.

Tungsten Lighting

Tungsten lighting in the home has now become standard with the latest developments of wire drawn filaments. For street lighting in smaller towns and in side streets of the large towns and cities they are being invariably used, some very efficient series systems having been developed. Series tungsten street lighting, has received an additional impetus through the development of the nitrogen filled type of tungsten lamp. The old method of supporting lamps on expensive center span suspensions is giving way to the use of the hinged tungsten arm, which permits the lamp being supported beyond the line of foliage of the trees, and still be accessible for cleaning and renewals, at a cost of approximately one-third of the old way.

High Voltage Transmission

Steel frame towers with suspension insulators have become the established practice for voltages of 60,000 and over. During the year the flexible or A frame type of tower appears to have found its field in high voltage work both for single and double circuits. For lower transmission voltages there appears to have been considerable inquiry for steel poles of moderate cost which can be spaced 200 to 300 feet apart and furnish a permanent type of construction at about the same cost as the old wooden pole line. This demand is now being met satisfactorily by a number of manufacturers.

Meters

Developments have chiefly been along the line of refinement in construction, as one manufacturer states "frames of all forms have been stiffened by flanging the edges and along one side of the disc opening. The magnet supports have been altered to eliminate any possible springing. The new support is an aluminium bronze casting stiffened by ribs, and the shape has been changed to reduce the over-hang. The fulcrum support on which the magnet support is pivoted is fastened to the frame by four screws instead of by two as formerly. The micrometer adjustment of the magnets is not changed except that larger screws are used. These changes greatly reduce the possibility of damage or derangement from rough handling, etc."

During the year there has been some inquiry for the two rate system of meter and also for the prepayment type. One company has introduced on the Canadian market a current limiter, which by a simple device prevents the customer from taking more than a stated amount of current off the line.

A new totalising meter has also made its appearance and promises to be in demand with the larger operating companies.

Electrical Fittings

Unusual activity has been evidenced along the line of small fittings following the development in electrical contracting and the activity of municipalities and companies in demanding more rigid inspection. The class of work now being installed is greatly superior to what it was two or three years ago and there has been an increased demand for conduit, condulets, outlet boxes, etc. The demand for this equipment is shown in the fact that one Canadian company have, during the past year, developed a complete line of wiring devices, key and keyless sockets, knife switches, etc.

Electrical Control of the Panama Locks

A Detailed Description of the Control of the Canal Locks, Terminals and Auxiliary Equipment which are all Electrically Operated

The electrical specification, design and manufacture of the Panama Canal centralized control system may properly be regarded as one of those undertakings which, from an engineering standpoint, not only arouses a lively interest but also presents an opportunity for much valuable instruction. The interest results mainly from the immensity of the canal project itself, and the instruction from a consideration of the methods employed to insure the passage of even the largest ships afloat across the isthmus with speed and safety. The complete operation of the canal locks, terminals and auxiliary equipment utilizes electrical energy throughout, with the present exception of the Panama railroad, the electrification of which is under contemplation.

The specifications for the entire generating, lock controlling, and distribution system for operating the Panama Canal were prepared under the supervision of Mr. Edward Schildhauer, electrical and mechanical engineer, Isthmian Canal Commission, assisted by a staff of able electrical engineers, including Mr. C. B. Larzelere, who was closely identified with the lock control problem, and Mr. W. R. McCann with the generation and distribution of power. These specifications exhibited great care and painstaking engineering. They contained every safeguard that expert engineers could suggest, were exact and explicit in regard to the results required, yet gave proper range in the details of accomplishment.

Generation and Distribution

The power system for the operation of the locks, towing locomotives, lights for the locks and buildings, and motors not directly connected with the lok control, is composed of:

One 7500 kv.a. 2200 volt hydro-electric power plant at the Gatun dam;

One 4500 kv.a. 2200 volt Curtis turbo-generator electric power plant at Miraflores for emergency, lately used to supply power for construction work;

A double 44,000 volt transmission line across the isthmus, connecting Cristobal and Balboa with the two power plants;

Four 44,000 2200 volt sub-stations, stepping down at Cristobal and Balboa, and up or down at Gatun and Miraflores, depending on which of the two plants is supplying power;

Thirty-six 2200 240 volt transmission stations for power, traction and light at Gatun, Pedro Miguel and Miraflores locks;

Three 2200/220/110 volt transformer stations for the control boards at the locks;

Stations at Cristobal and Balboa for coal handling plants, machine shops and dry docks.

The system of connection throughout employs a double bus, double switch scheme, with provision for disconnecting any oil switch for cleaning or repairs without interrupting the circuit. In the power house and the four 44,000/2200 volt sub-stations, the oil switches are solenoid operated and are installed in concrete cells, above which are concrete fireproof compartments containing the two sets of buses. In the thirty-six transformer stations in the lock walls the oil switches are hand operated. All 2200 volt oil switches have disconnecting switches, so arranged that live parts are completely covered.

For the hand operated switches, a pipe framework supports vertical metal guides which carry the oil switch operating mechanism and slate base forming a section of the switchboard panel. On the guides a lever and toggle mechanism is mounted, by which the oil switch and slate base may be raised and lowered. Above the oil switch and mounted on the pipe framework a stationary cast iron base carries the disconnecting switch studs and insulators. The high tension leads run to the tops of the disconnecting switch studs, and the bottom of each stud is equipped with contact fingers. On the top of each oil switch stud is mounted a contact blade. When the oil switch is raised, these blades engage the contacts on the bottom of the disconnecting switch studs, which thus in the closed position form extensions of the oil switch studs. The disconnecting switch contacts are surrounded by insulating shields which prevent accidental contact. When the oil switch is lowered, it is completely isolated from the circuit. When the oil switch is raised, it always goes to a fixed height where it is latched. An interlock prevents the oil switch from being raised or lowered unless its contacts are open, precluding the circuit being closed or opened by the disconnecting switch.

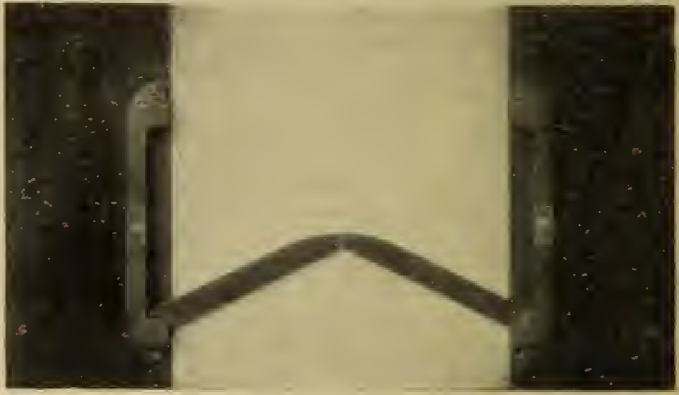


Fig. 1—Miter gate index, lock control board

In some instances another interlock makes two single-throw switches a double-throw switch and prevents both switches being closed at the same time.

For solenoid operated switches, the same form of disconnecting switch is used; but the solenoid is stationary and the connecting mechanism to the oil switch has a vertical slotted link which allows the oil switch to be raised and lowered without being disconnected from the solenoid mechanism. A mechanical interlock prevents the raising or lowering of an oil switch while in the closed position.

The instrument and control board for the Gatun generating station is of natural black slate, as are the switchboards for the power system. It is totally enclosed by means of grill work with doors at each end. The switchboards for the transmission line sub-stations are of the vertical type, with control apparatus and mimic connections symmetrically arranged on the middle section of the panels. The rear of the board is enclosed by means of grill work with doors at each end.

Power supply and control panels for lock machinery motors

Current for the lock machinery and towing locomotives is transformed from the 2200 volt system in the immediate vicinity of where it is used. There are a total of thirty-six transformer stations, for all locks, each containing duplicate

200 kv.a., 3-phase, 2200/240 volt transformers for power, and one single-phase, 25 kv.a., 2200/220 110 volt transformer for lighting. The stations, normally fed from the 2200 volt buses in the 14,000/2200 volt sub-stations, can also be operated from the power plants—the stations at Gatun locks from the Gatun hydro-electric station, and the stations at Miraflores and Pedro Miguel from the Miraflores emergency steam plant.

As giving an idea of the number and size of motors used in operating the lock machinery, the following table is interesting:

Machines and Operation	Motors each Machine and H.P.	Number of Motors				Total Horse Power
		Gatur	Ped. M.	Mira.	Tot.	
Miter gate, moving, each leaf	1-25	40	24	28	92	2300
Miter gate, miter forcing....	1- 7	20	12	14	46	322
Fender chain, main pump	1-70	16	16	16	48	3360
Fender chain, operating valve	1-½	16	16	16	48	24
Rising stem gate valve......	1-40	56	24	36	116	4640
Cylindrical valve	1- 7	60	20	40	120	840
Guard valve	1-25	6	6	6	18	450
Auxiliary culvert valve	1- 7	4	4	4	12	84
Totals		218	122	160	500	12020

There are many motors not included above, as, for instance, those for the spillway gates, for the hand rails on the mitering gates and for the sump pumps. The spillway gates are remote controlled from a special control board, and the control of the hand rail motors is given in connection with the discussion of mitering gates.

The motors are started and controlled by contactor panels located near them, the contactors of which handle the main motor currents. These contactors are controlled from the central control house. The smaller motors, including those for cylindrical valves, auxiliary culvert valves and miter forcing, are started by being thrown directly on the line. Two double-pole contactors are used, one for forward and one for reverse. In the case of larger motors for miter gate moving, rising stem valves and guard valves, a starting point with resistance in two legs of the three-phase circuit is provided.

In all cases the contactors are operated from the control boards—to be described later—by three wires, one for forward, one for reverse and a common return. In the case of panels having a starting point, the period during which the motor remains on the resistance is automatically controlled by a dashpot, so that the starting operation at the control house is the same, simply energizing a forward or reverse wire as the case may be. The control connections are arranged in such manner that each individual machine may be controlled locally. This arrangement provides for emergency operation should the control circuits from the central control house be out of order.

Location and operation of lock machinery

From an operating standpoint the machinery was placed below the coping of the lock walls, thus affording a clear space for manoeuvring ships and protecting the apparatus from the weather without erecting numerous houses.

The Gates

The mitering gates consist of two massive leaves, shown in miniature in Fig. 1, pivoted on the lock walls which operate independently of each other. A pair of gates is located where each change of level occurs and divides the locks into 1,000-foot chambers. In addition to these gates, at lake and ocean ends there are duplicate pairs of gates used as guard gates. To handle the vessels of various sizes with the minimum use of water, mitering gates of the same description as those above are installed, dividing 1,000-foot locks into two compartments. These gates are termed intermediate mitering gates. When the mitering gates are closed they are what might be termed clamped in this position by a device called a miter forcing machine.

On the top of all mitering gates a foot walk with hand rails is provided. When the gates are opened and in the recesses provided for them in the lock walls, these hand rails would interfere with the passing of the towing locomotives, except in the case of the lower guard gates. The hand rails are therefore made to be raised and lowered. This is done by a motor under the foot walk, controlled from the lock wall. Near the approach to each foot walk a controller is located in the lock wall flush with the surface, this controller being operated by a foot push. If the gates are closed and the hand rails are down, and it is desired to cross on the gates, the foot push is pressed and the hand rails are raised by their motors. This is true not only of the hand rails on the nearer gate leaf, but of the hand rails on the farther leaf as well. After passing across, one can, if one desires, press the foot push on the other side and both hand rails will be lowered. Or, if one leaves the hand rails up and the gates are opened by the operator in the control house, they will be automatically lowered so as to be out of the way when the gate is in the recess. When the gates are again closed, the hand rails will automatically rise again if the foot controller has not been operated in the mean time. The hand rails cannot be raised when the gates are opened and no harm results if the foot switch is operated while the gates are in the closed position.

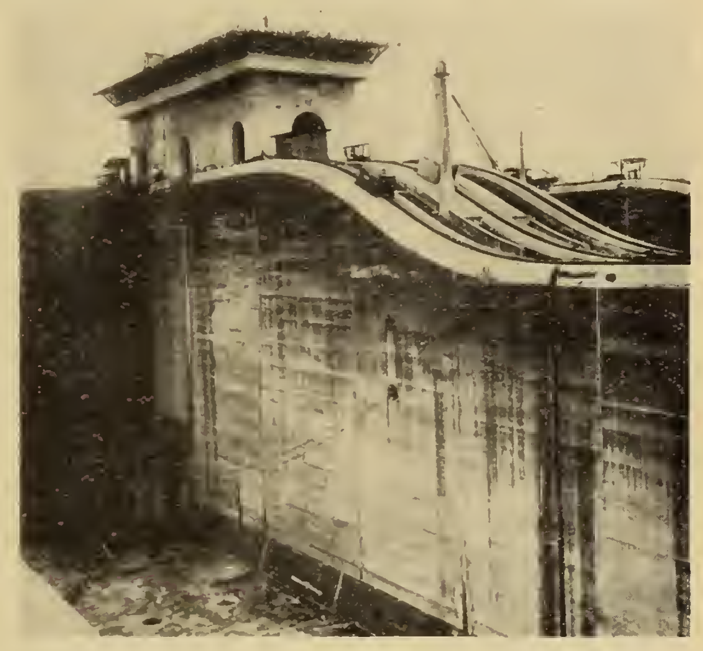


Fig. 2—View of channel, showing control house, centre wall and towing track incline

Chain fenders

The chain fenders are stretched across the canal in front of all mitering gates which can be exposed to the upper lock level and also in front of the guard gates at the lower end. These chains are maintained in a taut position when the gates behind are closed, and are lowered when the gates are opened for the passage of a ship. The chains are raised and lowered by a method similar to that followed in hydraulic elevators, with the additional feature that if a ship approaches the gates at a dangerous speed and rams into the chain, the chain is paid out in such a way as to gradually stop the ship before it reaches the gates. Lowering the chain for the passage of a vessel and raising it again after the vessel has passed is accomplished by two motors; one driving the main pump supplying water under pressure, and the other operating a valve which controls the direction of movement of the chain. These two operations are combined in one, each motor being stopped automatically by a limit switch when the has performed its function.

Filling and emptying

The filling and emptying of the locks is accomplished by three culverts, one in the middle wall and one in each side wall, the flow of water being controlled by rising stem valves. They are located in the culverts at points opposite each end of each lock so that the culvert can be shut off at any desired point for filling a lock with water from above, or upstream, or for emptying it by allowing it to flow out and down to the next lock. Lateral culverts conduct the water from the main culverts, under the lock chambers, and up through openings in the lock floors (See Fig. 2).

The rising stem valves are installed in pairs, and each pair is in duplicate; also each culvert is divided into two parallel halves at these valves by a vertical wall. This arrangement reduces the size of each valve and make it more easily operated, each valve being 8 by 18 feet. One pair of duplicates is left open as a guard, or reserve pair; the other pair is used for operating, so that in case of an obstruction in the culvert or accident to the machinery, the duplicate pair can be used.

At the upper ends of the culverts at the side walls, the duplication is accomplished by three valves in parallel, called the guard valves. They perform service exactly similar to the rising stem valves, except that three valves in parallel in this case must conform to the same laws as the two in parallel in the other case.

The culvert in the middle wall must serve the locks on both sides, and to control this feature cylindrical valves are placed in the lateral culverts that branch out on each side. There are ten of these on each side of the culvert at each lock.

At the upper end of each set of locks, there are two valves in the side wall for regulating the height of water between the upper gate and upper guard gate, as it is desired to maintain the level of the water between these gates at an elevation intermediate between that of the lake above and that of the upper lock when the upper lock is not at the same level as the lake. These valves are called the auxiliary culvert valves.

Reasons for control system adopted

As the flight of locks at Gatun, for instance, extends over approximately 6,200 feet, and the principal operating machines are distributed over a distance of about 4,000 feet, it can be readily seen that central mechanical transmission of control of machines would be almost impossible; and to control the machines locally would mean a large operating force distributed practically along the full length of the locks, which has invariably been the practice heretofore. Such a force would be difficult to co-ordinate into an efficient operating system. The situation therefore resolved itself into centralized electrical control, which reduces the number of operators, the operating expense, and liability to accident. To accomplish this system of control, a control board for each lock was constructed which permitted having all control switches located thereon mechanically interlocked so as to minimize, if not entirely prevent, the errors of human manipulations.

Centralized control and indicating system

The control boards, Fig. 3, are installed in control houses located on the middle walls at points which afford the best view of the locks, although this view is not depended on to know the position of the gates or other apparatus, as all are provided with indicators on the control board. The control boards are made approximately operating miniatures of the locks themselves and are arranged with indicating devices which will always show the position of valves, lock gates, chains and water levels in the various lock chambers; and with the exception of such machinery as needs only an "open" or "closed" indication, the indications will be synchronous with the movement of the lock machinery.

For such indication, appliances with commutators, multiple contacts or ratchet mechanisms would not be suitable because of the many contacts and small pieces in their construction; and particularly because devices of this character move step by step and would not indicate all points in the movement of the main machinery, such indications being more or less approximate according to the number of steps in the indicating devices. The indicators on the Panama control boards were developed especially for this undertaking and show accurately and synchronously every movement of the machinery to which they are connected, whether in the extremes of travel or at any intermediate point.

A complete synchronous indicator consists of a transmitter, Fig. 4, located at and operated by the machine in the lock wall, and a receiver, see Fig. 6, operating an indicator at the switchboard in the control house. Both transmitter and receiver have a stationary and a rotating part. The stators have three-phase windings with leads from three corresponding equidistant points brought out and connected together, but not connected to a source of power, the stator coils being energized by induction from the rotors. The rotors are bipolar and are connected in multiple and energized from a 110 volt 25 cycle single-phase source.

The movement of the lock machinery and with it the connected transmitter rotor produces a field in the transmitter stator polarized in the direction of the rotor axis, which induces voltage in the stator coils. This voltage is transmitted by the three-phase connection above mentioned to the receiver stator coils and duplicates in them, but in the reverse direction, the same conditiins of polarity and voltage as present in the transmitter. The rotor of the receiver, being energized by the external source in the same direction as that of the transmitter, is reacted upon by the polarized receiver stator until the magnetic axes coincide and the rotors of both transmitter and receiver are in the same relative position. Any difference in the position of the transmitter and receiver rotors causes a difference of potential between the stator windings with a consequent flow of current and resultant torque, which again moves the receiver rotor to the same relative position as that of the transmitter rotor. The receiver rotor follows closely and smoothly the movement of the transmitter rotor, and consequently imparts to the posi-

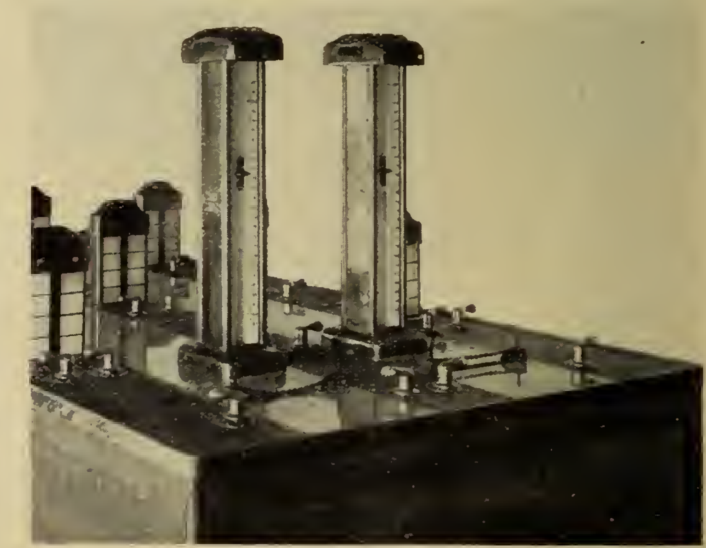


Fig. 3—Small part of centralized control board, Miraflores lock

tion indicator, a movement identical with the movement of the lock machine, although on a scale reduced to the requirements of the control board. A brief description of the individual synchronous indicators follows.

In the case of the mitering gates, the vertical operating shaft is connected to a shaft which operates the transmitter machine similar to mechanism in Fig. 4. The latter shaft is threaded and carries a nut on which is mounted a rack. The rack engages a gear on the rotor shaft and this turns the rotor as the gates operate. The mitering gate indicator comprises a pair of aluminium leaves, Fig. 1, shaped to correspond to the plan view of the top of the gate, which travel horizontally just above the top of the board, the hinge ends being connected to shafts extending down through the surface of the board where they are geared to the receivers by means of bevel gears. When the miniature gates are completely opened, they are covered by shields to give the effect of the gates folding back into recesses in the lock walls. These operate on the board shown in Fig. 3 but are not included in the portion reproduced.

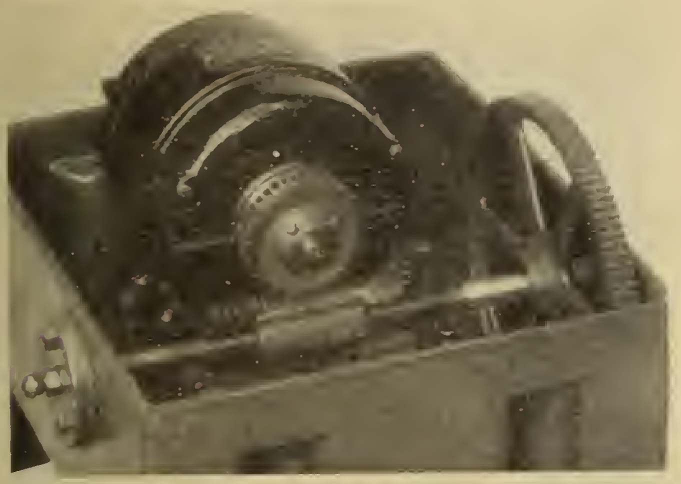


Fig. 4—Rising stem valve transmitter, cover removed

For the chain fender, the position indicator transmitter is driven by the shaft which operates the limit switch that controls the stroke of the piston. The indication on the board is given by a small aluminium chain, which, like the large chain, is raised and lowered, each end operating independently, the large chain being lowered to the bottom of the lock and the small chain into a slot on the control board, see Fig. 3. The ends of the miniature chain are fastened to semaphore arms which are connected to segmental gears meshing with the driving gears on the receiver machines. As the receiver rotors turn, the chain is either lifted or lowered, the position of the large chain from the bottom of the lock being indicated by the angle of the semaphore arms.

As the rising stem valves occur in pairs, their position indicator machines occur in pairs also. The transmitter rotor is driven by a shaft and gearing similar to that described for the mitering gates. Each indicator is similar to a small elevator, see Fig. 3, a car being used to indicate the position of the valve gate. Both front and back of the shaft is fitted with opal glass marked with black lines for the ¼, ½ and ¾ positions. (See Figs. 6 and 3). A small aluminium cage moves up and down in each compartment. A drum for operating the cord which raises and lowers the cage is located underneath the control board and is operated by the receiver through a suitable train of gears. To make the indications visible from points up and down the control board, the elevator shaft under each car is always illuminated and the position above is dark.

The specifications covering the water level indication required an accuracy of 1/20 of a foot or 1/10 of 1 per cent. in actual water level. In the transmitters and receivers for the machines described previously, the rotors turn less than 180 degrees with an inherent lag of 1½ per cent. between transmitter and receiver rotors in this distance, which obviously prevents this arrangement from being employed to give the water level indication.

It was found that if the rotors were revolved ten complete revolutions, the required accuracy could be obtained; but since this arrangement makes it possible for the rotors to be in synchronism every 180 degrees, or in twenty different positions for the entire travel, the indicators would not indicate correctly if for some reason the transmitter rotors were turned more than one-half revolution with the power off. Therefore, the required accuracy was obtained by two sets of transmitters and receivers, one set connected to a fine index in which the rotors make ten complete revolutions and the other set connected to a coarse index operating less than 180 deg.

The fine index (see Fig. 3, tall chimney-like structure) is a hollow cylinder carrying a pointer, the length of the cylinder being such that when an aluminium ball, representing the coarse index which can be depended upon for coarse indication, is within the limits of the cylinder, the reading of the fine index is correct within the limits specified. The scales are illuminated by lamps in both base and top caps of the indicator.

For water level indication, wells 36 inches square in the lock walls with communication to the lock by a small opening at the bottom of the well to dampen surges contain a welded steel box float, 30 inches square by 9 inches deep. A non-slipping prosphor bronze belt transmits the movement of the float to a sheave fitted with pins on the transmitter mechanism, the pins registering with holes punched in the belt. The sheave shaft is carried in ball bearings with oil cups for lubrication and drainage cocks at the bottom of the bearings.

The position of the miter forcing machine is not indicated by synchronous indicators, but its open and closed positions are shown by red and green lights and a mechanical indicator on the control boards representing the machine.

Control boards represent locks in miniature

The control boards are of the flat top benchboard type, 32 inches high by 54 inches wide, built in sections, with total lengths as follows:

Gatun	64 feet
Pedro Miguel	36 feet
Miraflores	52 feet

The side and center walls of the locks are represented by cast iron plates and the water in the locks by blue Vermont marble slabs, see Fig. 3. The outer edge of the board is surrounded by a brass trim rail and the sides are enclosed with steel plates which can be readily removed for inspection of the board. The control board is supported by a wrought iron framework resting on base castings, which are in turn supported on the operating floor of the control house.

The control switch handles are mounted above the surface of the board and operate through an angle of 90 degrees. They are provided with nameplates for the "open," "closed" and "off" positions. The space immediately below the flat top of the control board is occupied by the contact fingers of the control switches, mounted on the operating shaft, synchronous receivers and their cable connections (see lower half of Fig. 6). Connection boards are provided for the cables, which are led up from each side, as are buses for supplying current to the control switches, receivers and the lamps that illuminate the scales of indicators. The receivers, transmitters and lamps are operated at 110 volts, while the control circuits are 220 volts, both using 25 cycle alternating current.

Mechanical interlocking system

In order to make it necessary for the operator to manoeuver the control switch handles always in a certain order, corresponding to a predetermined sequence of operations of the lock machinery, and to prevent the operator in control of one channel from interfering with the machinery under the jurisdiction of the operator controlling the other channel, these control switches are provided with inerlocks. The interlocks are in two vertical racks under each edge of the board and some distance below, so that they may be inspected and oiled from a floor which is about seven feet below the floor on which the switchboard operator stands. The latter floor does not extend across under the board, this space being open so that all parts on the underside of the board are accessible from the floor below (see Fig. 7).

Vertical shafts operated by connecting rods from the control switch shafts extend downward past the electrical parts for the operation of the interlocks. The interlock system is essentially a bell crank mechanism, connecting the shaft to the control switch through a movable horizontal bar to a vertical operating shaft which can or can not move according to the relative positions of the interlocking bars and dogs. The interlocking rack is a steel frame carrying five horizontal members, Fig. 5. Upon these and tying them together are vertical steel straps which carry brass runway posts for the vertical and horizontal interlock bars. These posts are riveted to the vertical steel straps, a thin brass plate between posts and straps making the runways non-corrosive. The vertical operating shafts are of square steel, turned on the ends, and work in brass bearings near top and bottom of the interlocking rack. Forked cranks mounted on the vertical operating shafts move the horizontal interlock bars by means of pivot blocks set over pin blocks riveted to the horizontal bar. The interlock bars and dogs are of special shape, hard, extruded brass, which section keeps the dogs in line with the axis of the bars when under pressure by being engaged with another dog on a vertical bar. Every control switch uses a horizontal bar from 3 to 50 feet long.

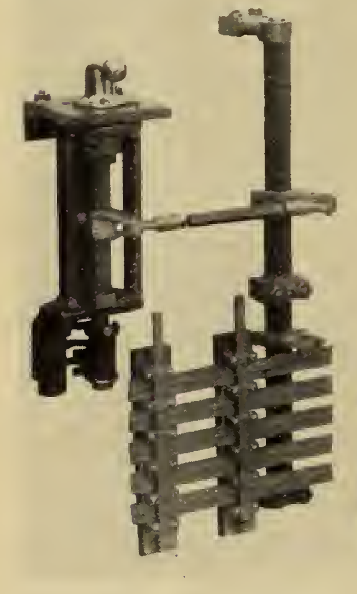


Fig. 5—Control switch and interlock mechanism

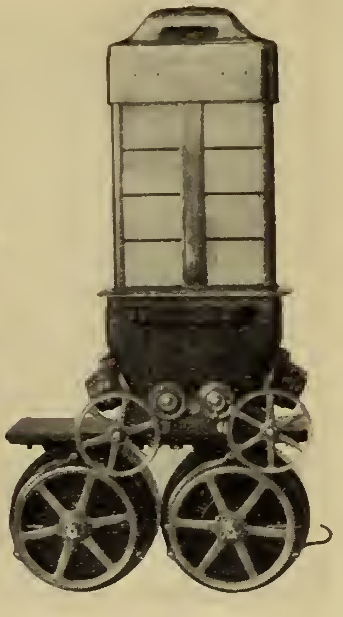


Fig. 6—Gate valve index for lock control board

The interlock system depends mainly on the action of engaging bevel dogs located on horizontal and vertical bars, the movement of a horizontal bar tending to lift a vertical bar by bevels on the dogs. A horizontal bar can not be moved without raising a vertical bar. Thus if at any time a dog on a horizontal bar rests against the upper end of a dog on a vertical bar, no movement of the horizontal bar where the dog engages with the vertical bar can take place, and the control handle connected to that particular horizontal bar is locked.

Interlocks prevent the chain fender from being lowered until adjacent mitering gates have been opened, and also prevent the gates being opened until the chain is in the raised position. In this way it is assured that the chain fender will always be in the up position to protect the gate when the gate is closed. To avoid unnecessary complication, each end of the chain is interlocked with the leaf on its side of the lock only, because as a rule both leaves of a gate, as well as both ends of a fender chain, will be opened simultaneously, and further interlocking is unnecessary. After the mitering gates are closed a miter forcing machine is operated by a control handle and locks the ends of the gates closed. This machine cannot be operated until the gates are closed.

Also the rising stem valves of the side wall, next above or below a miter gate, must be closed while the miter forcing machine is open. As the miter forcing machine cannot be closed until the gates are closed, this means that the valves either above or below the gate must remain closed until the gate itself is closed, thus preventing the operator from creating a current of water around the gates while they are open, or being moved in opening or closing. This interlock is not included on the middle wall valves for the reason that they will be used with the locks on either side and must be free for that purpose.

Either pair of rising steam valves may be opened first, at the choice of the operator, an interlock becoming effective when the first valve of the second pair of duplicates is opened. This is done by a novel arrangement of equalizing levers acting against the ends of the interlock bars, with certain definite amount of lost motion which is taken up on opening the first pair of valves, thus putting the interlocks in operation on the next pair. To illustrate this operation, consider, for example, a side wall culvert at Gatun with its principal rising stem valves at each change of level from one lock to the next. The control of these valves is interlocked so that if the valves are opened at one particular point, the valves a lock length upstream or downstream cannot be opened. Thus the operator is limited to equalizing the water between locks and cannot allow water to flow from the upper lock past the middle lock into the lower lock, which operation, if permitted, might flood the lower lock walls and the machinery chambers in them. The cylindrical valves are interlocked so that if those on one side are opened the ones on the other side are locked closed, and the opening of one switch on a side will lock the opposite ten. This prevents careless cross filling between locks, which operation might be combined with the regular method and produce flooding. However, there may be times when it is desirable to employ cross filling to economize in the use of water from Lake Gatun in the dry season. For this reason this interlock is made removable by the use of a Yale lock and key. The key will be placed in the hands of the chief operator.

In the use of the middle wall culvert, the cylindrical valves on one side or the other must be opened before the rising stem valves can be opened, and the rising stem valves must be closed first. This interlock is applied in order to require the operator to control the flow of water by means of the rising stem valves rather than by the cylindrical valves.

In most cases the locks are divided into two unequal parts by the intermediate mitering gates. This arrangement makes it necessary to divide the ten cylindrical valves into two groups of seven and three, respectively, for the long and short lengths. A selecting lever is provided for these interlocks and may be set as indicated by a nameplate on the lever to "three," "seven" or "ten" respectively; whereupon the corresponding valves are subject to that interlock.

and the others of the group of ten are locked closed if three or seven only are to be used. The failure of the operator to make his selection properly in advance will simply cause him the trouble of going back and doing so, as the remaining valves are locked closed. This arrangement permits handling small vessels without causing waste of water due to operating such vessels in the large chambers. If a short vessel were being passed downstream, it would first pass into the chamber having three sylindrical valves. The group selective lever would then be placed on the "three" position which would permit the opening of three valves above the intermediate gate, but would lock closed the other seven valves above it. After the vessel had been passed below the gate the handle may be reversed releasing the lever and locking three switches.

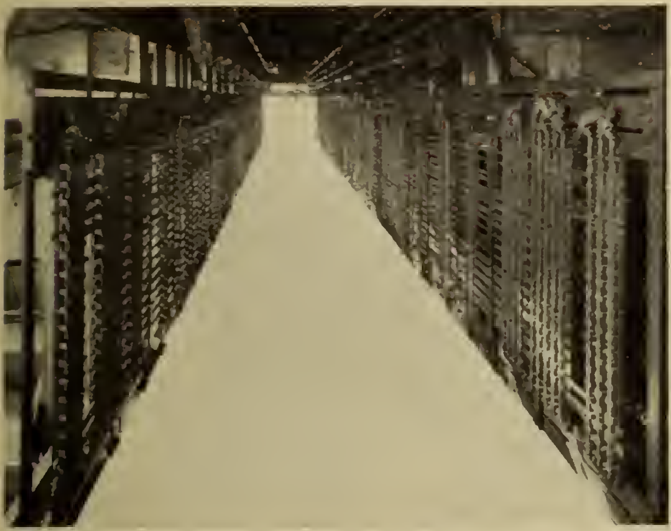


Fig. 7—Interlocking system below the Miraflores board—Floor not yet installed.

There are intermediate rising stem valves ih the side walls at each intermediate gate, but no interlocks are applied to these for the reason that they will be used in a more or less irregular manner, and no fixed laws for their operation can be made in advance. Moreover, they control the water only between different sections of the same lock, and there is not the danger from mistakes in operation which exists in the case of the other valves which control water between lock levels. The same is true of the small auxiliary culvert valves, by means of which the space between the upper guard gate and upper main gate is filled and emptied.

In case a large vessel is to be locked through, the interlocks on the intermediate gates can be made ineffective by the operation of a Yale lock which uncouples a clutch and disconnects the central switch from the operating mechanism. Turning the key removes the interlock and permits the intermediate gates to be thrown open to obtain a 1,000-foot level and the valves operated independently of these gates.

To obviate the possibility of flooding the locks when valves are in a certain position, diagonal interlocking is introduced between the rising stem valves of the side wall and those of the middle wall a lock length away. This interlocking between valves diagonally across a lock when the cylindrical valves are open is needed to prevent the flow of water from, say, the upper lock by way of a side wall culvert to the middle lock, thence by way of the middle wall culvert to the lower lock, thus allowing an operator through carelessness to flood the lower lock walls. If the cylindrical valves of a certain lock are closed, the interlock is not needed on the rising stem valves of that lock; and since such interlock would interfere with the proper use of the valves of its twin lock on the other side of the middle wall, this interlock is automatically removed when all ten cylindrical valves are closed on the particular lock in question, and is automatically applied again if one or more of the ten cylindrical valves are opened. Furthermore, the valves of the side wall immediately at the gate which is being moved will be open to equalize water level, and diagonal interlocking will prevent the opening of the middle wall valves a lock length above or below the gate being moved. Each of the four valves of such a group has independent control, their control switches being so interlocked that either pair may be opened and left open as guard valves, the interlocks becoming effective when the operator tries to open the first valve of the second pair. In addition to these pairs of valves in parallel, each pair is duplicated at each change of level from one lock to the next.

Interesting manufacturing details

Nearly two thousand special drawings were required in the fabrication, and there were also involved the following unusual quantities of materials:

Special slate bases		1,300
Small castings		160,000
Screw machine parts		1,200,000
Copper rod and bar	ft.	58,000
Asbestos lumber	sq. ft.	9,000
New patterns		650
New jigs, templates, tools, etc.		625
Porcelain parts		18,000
Special bus supports		6,800
Galvanized pipe (framework)	ft.	21,000
Special gears		2,300
Special instruments		640
Miscellaneous sherardized pieces		300,000
Cases for boxing		4,150

The combined weight of the centralized control boards for Gatun, Pedro Miguel and Miraflores is about 39 tons.

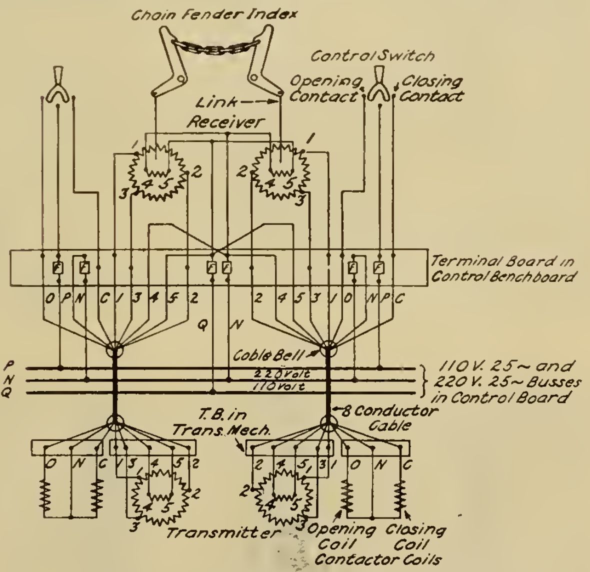


Fig. 8—Wiring for control switches and syncheronous position indicator for chain fender index

In their construction there is employed more than 2¼ miles of interlocking rod; about six million feet of control leads—made up in 5 and 8 conductor cables; 732 indicator motors; 464 control switches.

All of the lock machinery motors, control panels, centralized control boards, power station generating apparatus, switchboards, transmission line sub-station equipments, coaling stations, and practically the entire electrical equipment for the wharf terminal cranes and for the extensive permanent repair machine shops were manufactured by the General Electric Company.

Welding Chain Links by Electricity

By Mr. L. B. Powell*

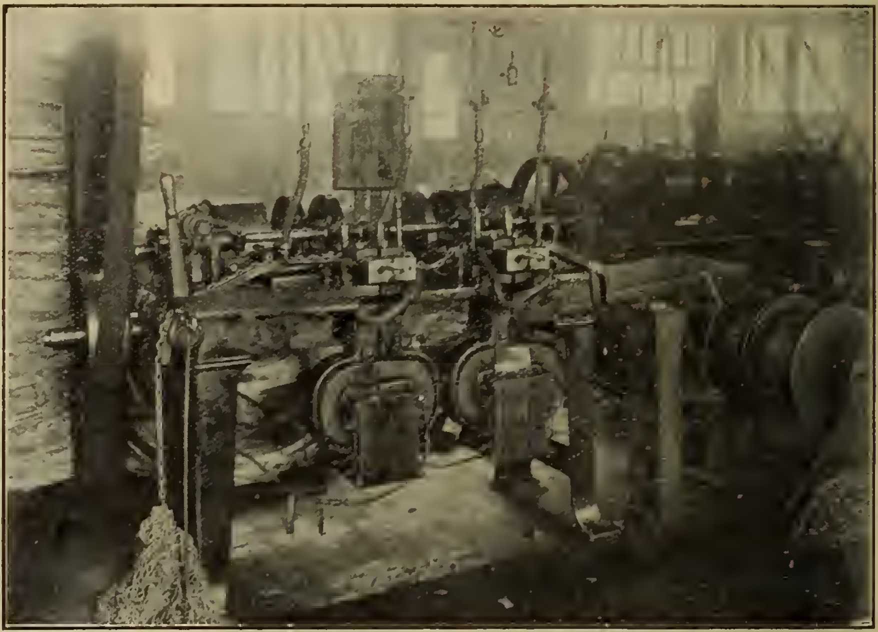
The electric welding of chain is a modern improvement, made necessary by the evils existing under the old style of manufacture. Chain above all other products needs the strength that is obtainable only by perfection of welding, and the invention of the automatic welding process is the result of experiments continuing over a long period of time, with a view to finding a method of forming and welding links that would result in every weld being absolutely perfect.

The machines illustrated herewith, reproduced from photograph of the McKinnon Chain Company's plant, are not the product of a chance thought but are the result of long study and expensive experiments resulting in continuous improvements, all of which are fully protected by patents in Canada, Great Britain, United States, and several European countries. The first operation in the manufacture of Butt Weld Chain is forming the chain into unwelded links on the forming machine shown in one of the illustrations. The coils of wire are fed into the machine from a spool and the operation of the machine is entirely automatic, linking the chain together ready for welding as shown. From the forming machine the unwelded chain is fed directly into welders of the type illustrated, the operation of which is entirely automatic.

Owing to the fact that alternate links present themselves for welding with the opening at different angles, these welders are constructed with two heads so that the first head will weld every other link and the second head will weld those in between, the chain being twisted between the first and second heads so that the link will be presented to the jaws of the welder in the same position. This arrangement is one of the patented features of these machines.

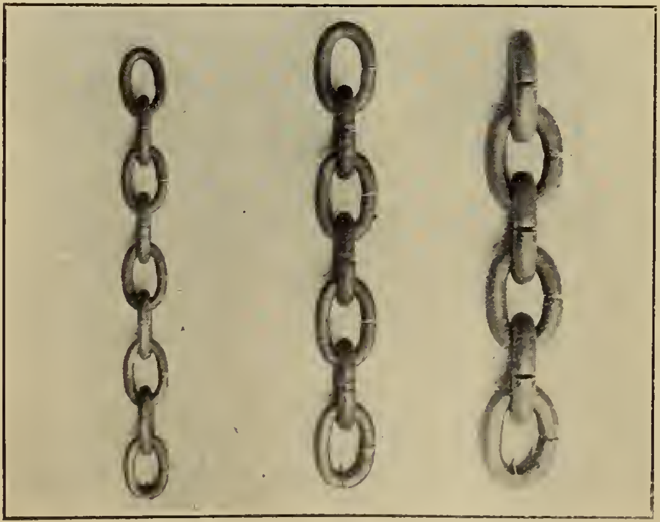
The electrodes of the welder meet the material on each side of the joint and, while the current is passing across the joint, the link is being given compression at the ends so that a junction of the material at the welding heat is being effected. The heat is developed by the passing of a large volume of current at a very low pressure (2 to 3 volts). The pressure is so low that the current cannot be felt even with both hands on the electrodes, while the volume is so great that ½-in. links come to a welding heat in 5 seconds and it requires a conductor or lead 8 inches square, of pure copper. A curious fact about copper used for such purposes is that one per cent. of impurity reduces its current carrying capacity by thirty-three per cent.

These welders are entirely automatic, with the pressure and current regulated so that each link receives exactly the correct amount to insure a perfect weld. This does away with the uncertainty of fire welding where the perfection of the weld is subject to the chances of want of skill or care on the part of the workman—burning or insufficiently heating the steel—and of dirt or sulphur in the fuel.

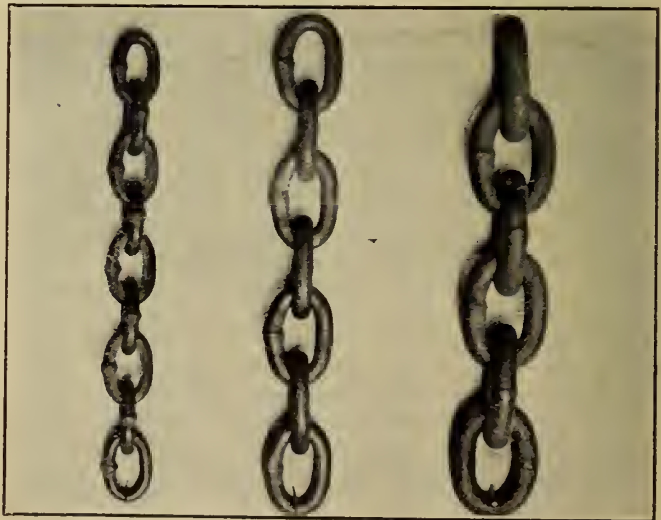


Welding chain links by electricity—The electrical equipment

One of the accompanying illustrations shows several sizes of chain just as they come from the welder and illustrates clearly the swell at the weld which is a feature of all McKinnon products. This swell is a natural result of the process of manufacture and while it could be reduced so that the weld would be equal in diameter to the balance of the link, such a reduction would not only take away the extra



Showing chain as it leaves the forming machine.



Showing chain as it comes from the welder.

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* Sales manager, McKinnon Chain Co., St. Catharines.

strength where most needed, but would have a tendency to weaken the weld mechanically, and in both these ways would reduce the quality of the product.

The swell at the weld does not interfere in any way with the use of the chain for practically all purposes and a great many tests have proven absolutely that the reduction of the weld would mean a decrease of almost 50 per cent. in the strength and wearing quality of the chain.

While records show that over 99 per cent. of the products of these automatic welders is perfect in quality of welding, yet nothing is omitted that will produce as near to 100 per cent. perfection as possible. For that reason every link of chain is carefully inspected after it leaves the welder and any links that may show evidence of imperfect welding are at once cut out and the chain is passed to the hand welder to be joined together before being tested.

The McKinnon Chain Company state that theirs is the only weld chain being made in Canada and that during the five years that the product has been on the market it has come into almost universal use among the leading manufacturers and users of chain throughout the country.

International Electrical Congress

The International Electrical Congress is to be held at San Francisco September 13th to 18th, 1915, under the auspices of the American Institute of Electrical Engineers by authority of the International Electrotechnical Commission, and during the Panama-Pacific International Exposition. Dr. C. P. Steinmetz has accepted the honorary presidency of the congress. The deliberations of the congress will be divided among twelve sections which will deal exclusively with electricity and electricity and electrical practice. There will probably be about 250 papers. The first membership invitations will be issued in February or March, 1914. The meeting of the International Electrotechnical Commission wil lbe held during the week preceding that of the Electrical Congress.

Attention is drawn to the distinction between the International Electrical Congress and the International Engineering Congress, which will be held at San Francisco during the week immediately following the electrical corgress. The engineering congress is supported by the Societies of Civil, Mechanical and Marine Engineers and by the Institution of Mining and Electrical Engineers, as well as by prominent Pacific coast engineers who are actively engaged in organizing it. This congress will deal with engineering in a general sense, electrical engineering subjects being limited to one of the eleven sections which will include about twelve papers, treating more particularly applications of electricity in engineering work.

A Substitute for Cement

In Turkey, where cement is not used or hardly known, a substitute has been found that has met with rather good results when applied in exposed places, in filling crevices in water pipes, covering joints in stone floors, in fountains, and for numerous other purposes where cement would be required. The mixture is as satisfactory in water as in exposed places, but it must be allowed to become thoroughly dry before it is submerged.

The mixture is slaked lime, linseed oil, and cotton fiber. Generally a hollowed-out stone is used, although a flat, hard surface will answer, and the process is started by pouring the oil on a handful of cotton, after which the lime is dusted in. It is then kneaded until the whole is thoroughly mixed and about the consistency of dough. The more it is kneaded the better it becomes.

This compound has undergone a severe endurance test at this consulate. Two years ago the stone floor in the balcony on the north side of the house leaked in several places and rotted the woodwork supporting the balcony. The floor was finally taken up, new timber added, and the stone flags again put down. Between each stone this mixture was forced in and smoothed over the joints. It took several days for hardening, the oil spread out on the stones for about half an inch from each joint, leaving a slight mark, but the compound soon hardened like cement, and today the surface over the part where the stones are joined is as hard and smooth and water-tight as if cement had been used.—Daily Consular & Trade Reports.

Window Decorations as Advertisements

The Toronto Hydro-electric Commission are paying particular attention to their window decorations as being one of the most satisfactory means of advertising electrical equipment. The Commission are fortunate in having a show room that is admirably located in that it is probably passed by as many prospective purchasers during the day as any other point in Toronto. The great care that has been taken with the demonstrations coupled with their frequent changes has made the Hydro windows a source of very great interest to the average citizen who makes it a point every time he passes to see what is new in the household supply business.

The particular exhibit shown here was in connection with a demonstration of electric cooking ranges. The window was fitted up as a model kitchen and demonstrations were given daily by a competent operator between the hours of 11 a.m. and 1 p.m. and 2.30 p.m. and 5 p.m. All kinds of food were cooked and a menu printed daily and displayed showing just what was being prepared. A blackboard was also placed in the window on which were written various cooking recipes and information relative to the ranges and their operation.

Display of electric stoves in model kitchen.

To prove the claims made for the wire drawn tungsten, the Toronto Hydro System recently installed in their show window a very ingenious device by which people were shown how really strong and reliable tungsten lamps are. The device consisted of a rocker arm which was moved up and down by an eight-sided fibre wheel, no two sides being exactly the same size. This wheel was driven by a small 1/8 h.p. motor equipped with belt and pulley. Ten sockets were provided in the rocker arm into which ten 25 watt 115 volt tungsten lamps were screwed. Two make and break contacts allowed the lamps to be alight all the time, and the display, according to Mr. C. H. Dudley, who has charge of the lamp and appliance department, drew big crowds to their window.

New Plant in Melville

The town of Melville, Sask., situated some 275 miles west of Winnipeg, the second divisional point on the Grand Trunk Pacific Railway, and boasting a population of nearly 3,000, has just installed an electric plant, a brief description of which is given herewith.

The generating equipment of the station consists of two units. One is a Swedish General Electric 75 kv.a., 3-phase, 60 cycle, 2800 volt machine belted to a Daniel horizontal single cylinder, 4-cycle, 85 h.p. gas engine. The second unit is also a Swedish General Electric machine, 150 kv.a., 3-phase, 60 cycle, 2400 volts, direct connected to a Tangye vertical, 3-cylinder, 4-cycle, 220 r.p.m. engine. Both generators are of the revolving field type, Y connected, with exciters on the same shaft forming an integral part of the main machine. Each exciter is only of sufficient size to excite its own dynamo. The lubrication on both engines is manual except in the crank chamber of the larger machine, where it is of the splash and force feed type for inaccessible places.

The switchboard consists of six panels of white marble each 30 in. x 48 in. mounted on pipe frame. These comprise two generating panels with ammeters, volt meters, oil switch and automatic release; one panel for the main town feeder which feeds both power and light users for the whole town; two panels for the two 50 h.p. motors which operate centrifugal pumps and one 20 h.p. motor connected to a deep well plunger pump by means of a belt which is also connected to an air compressor, used in connection with the starting of the gas engines, and one panel for the constant current transformer used for street lighting purposes. There are no lightning arresters at all on the system, the feeders, after passing through the switchboard being brought out through the same opening in the side of the building. No regulator has been installed either at the station or on the line.

The local distribution is at 2400 volts carried on 30 and 35 foot white cedar poles with four pin cross arms. No. 6 and No. 8 B & S weather-proof copper wire is used throughout on primary and secondary. This, however, has been found to be rather small, which, combined with the lack of regulation equipment allows considerable voltage variation on the line.

The water for the town is obtained from a well 175 feet deep and the water is pumped into a reservoir by means of a deep well plunger pump operated by the 20 h.p. motor mentioned above. The high pressure equipment consists of two Stillman-Watson centrifugal pumps, each connected to a 50 h.p., 2400 volt, 3-phase, 60 cycle, Swedish motor. The piping is so arranged as to permit operation of these pumps either singly or in parallel.

The current charges in Melville are 14c per kw.h. with 10 per cent. discount if paid before the 12th of the following month. A straight 3½c rate for power is also given.

New Books

Publications reviewed under this head may be obtained, in future, direct from the publishers of the Electrical News.

American Electricians' Handbook—By Terrell Croft; McGraw Hill Book Co., Inc., publishers; price $3.00 net. This is a practical man's handbook. In compiling the matter the object has been to collect such information as will enable practical electrical men—wiring men, contractors, line men, small plant superintendents, operators and construction engineers to select and install commercial electrical apparatus and materials and to operate the equipment after it has been installed. A minimum of theory is given and theoretical discussions have been included only where absolutely necessary. Illustrations and diagrams—every one of which was specially prepared for this book—have been used very freely. A number of special problems are solved to indicate the application of the rules that are given. The handbook is attractively bound in pocket size and appeals to us as covering the field claimed for it better than any book we have previously seen. Especially the sections on outside distribution and interior wiring are practical and complete. The handbook includes six sections in all, as follows:—Fundamentals, Generators and Motors, Outside Distribution, Interior Wiring, Transformers, Illumination.

Insulation & Design of Electrical Windings—by A. P. M. Fleming, M.I.E.E., and R. Johnson, A.M.I.E.E. Longmans, Green & Company, publishers, and distributed in Canada by the Renouf Publishing Company, 25 McGill College Avenue, Montreal, agents for the publishers in the Dominion of Canada and Newfoundland; price $2.25. In this treatise the authors have endeavored to set forth the underlying principles and methods whereby the design of insulation can be carried out with precision, and have embodied the result of many years of practical experience in connection with insulation problems. Insulation is one of the most important parts of electrical machinery but the unmechanical nature and general unsuitability of commercial insulating materials for withstanding high temperatures and stresses has discouraged any very wide spread scientific investigations of directly practical applications. The present publication will therefore be studied with interest. The scope of the work may be judged from the following chapters:—(1) Physical Characteristics of Dielectrics; (2) Electrostatic Conditions in Practical Working; (3) Insulating Materials; (4) Design of Insulation and Winding; (5) Insulation Tests; (6) The Drying and Handling of Electric Windings; (7) Insulation Failures.

Elementary Graphic Statistics,—by J. T. Wight, A.M.I. Mech. E., Whittaker & Co., London, publishers; price 4s net. This is written in the form of a text book for students who may be in search of a working knowledge of the application of graphic methods to the solution of the simpler problems met with in engineering and building construction practice. The following headings indicate the scope of work;—(1) Composition and Resolution of Forces; (2) Simple Practical Problems; (3) Composition of Non-Concurrent Forces; (4) Bending Moment and Shearing Force Diagrams; (5) Beams with Rolling Loads; (6) Roofs—symmetrical—Dead Loads; (7) Roofs—Unsymmetrical Loading; (8) Roofs—Wind Pressure; (9) Braced Beams and Girders; (10) Centre of Gravity —Neutral Axis—Resistance Figures—Moments of Inertia; (11) Retaining Walls.

Village Electrical Installations—by W. T. Wardale, A.M.I.E.E., Whittaker & Co., London, Eng., publishers; price 2s net. This is a small book of some 80 pages containing chapters on the following topics;—(1) Why Village Schemes are Now Financially Possible; (2) Formation of the Company; (3) the Generating Station; (4) the Overhead Line; (5) the Choice of the Plant; (6) Capital and Running Costs of Various Plants; (7) the Switchboard and Battery; (8) House Service and Connections; (9) the House Wiring Department; (10) Methods of Charging by Meter or Contract; (11) the Man to Manage the Installation; (12) Hints on Running the Plant; (13) Taking Electricity from a Power Company.

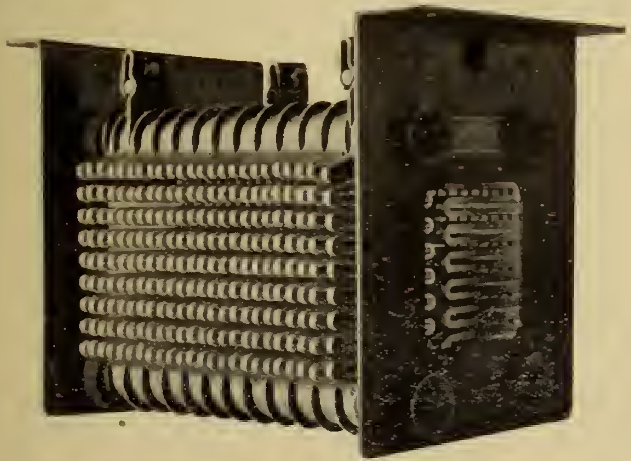
Among the Canadians included in the New Year's honor list is Henry Kelly Egan, of Ottawa, who is well known in electric circles, being a director of the Montreal Power Transmission Company and associated with the Ottawa and Hull Power Company. Sir Henry was born at Aylmer, Que., in 1848. He is connected with a number of important companies and is also prominent in connection with charitable and philanthropic work in Ottawa. Sir Henry has several times declined nomination for a seat in the House of Commons.

Electric Railways

A New Railway Rheostat

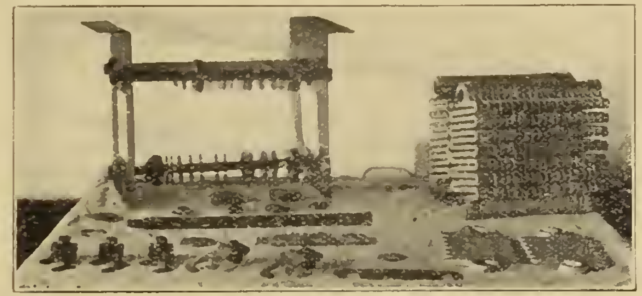
The Canadian General Electric Company have recently brought out a rheostat for railway service that is claimed to be superior, in construction, in ease of replacing grids and in general reliability, to anything on the market. This is known as the R. G. type of rheostat and its general characteristics are stated to be: breakage of grids reduced; greater reliability; grids can be easily replaced; greatly improved insulation on tie rods and in washers throughout, in place of mica; less sagging and warping from overloads.

The improvement in reliability of rheostats for railway equipments depends largely upon making them so that there is less chance of grids becoming broken, short circuited, grounded or burned out under the heavy overloads which rheostats for railway service are subjected to. The most satisfactory material for grids as proven by tests and years of service, is cast iron of the best grade giving maximum strength and elasticity, coated with a special compound found to materially prevent rusting. The grids in these rheostats are shaped so as to be most serviceable, and are mounted between light pressed steel frames reinforced where the rods are supported in them. The grids have convolutions as short as is consistent with good engineering practice. Each grid is supported at two points; but the short convolutions and large cross section render them extremely rigid, thus eliminating the liability of breakage or short circuits due to vibration. Furthermore, the grids are so rigid that when suddently cooled after having been subjected to heavy overloads, they are not apt to break; a feature which in itself renders this type more reliable than others on the market for similar service.



Rheostat assembled.

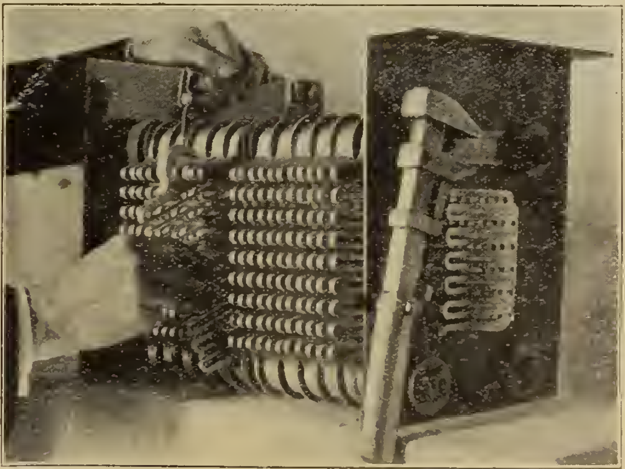
The use of a new form of insulation in place of mica for insulating the rheostat tie rods and for insulating washers used in this type of rheostat, has found most satisfactory in service on some of the largest railway systems in Canada. The greatest permissible creepage surface is used to insulate the grids from the supporting frame. Furthermore the grids are arranged in two sections; therefore there is only half the potential between any two grids on the same rod. While the insulation is sufficient for them to withstand all conditions of heat and weather, it is recommended that they be located in a position under the car where they will be reasonably free from wheel wash, which combined with brake shoe dust, tends to reduce the factor of safety of the insulation.



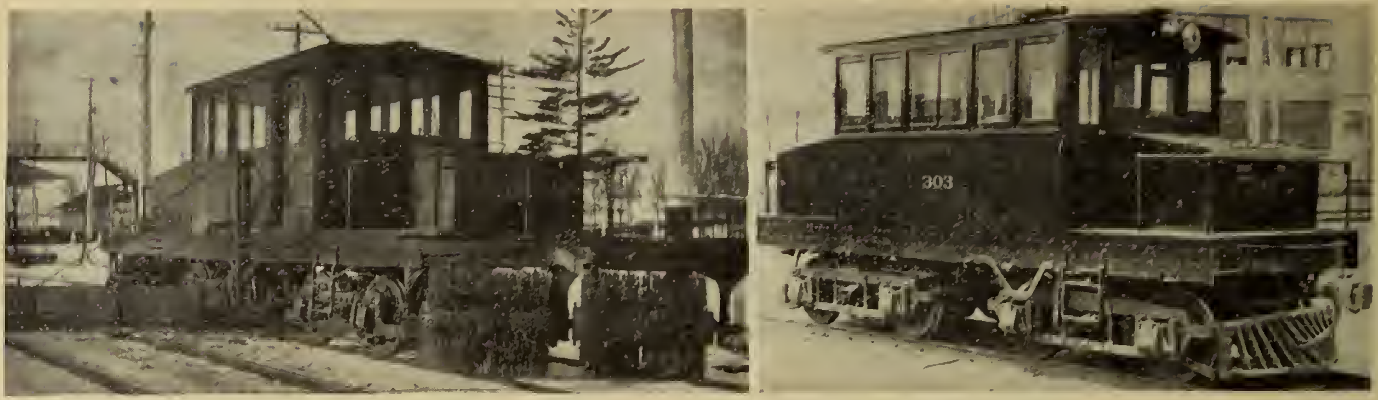
Rheostat dismantled.

After being assembled, each rheostat is given a complete and thorough test, including a potential of 5,000 volts applied between the frame and all of the grids. When supporting the boxes from the car, they may be readily insulated by mounting them on wooden beams, or by using insulated bolts.

In case of a grid being broken, it may be readily replaced without removing the rheostat from the car; thus saving the time which with other rheostats is required to discount, dis-assemble, assemble and again mount on the car. The grids are supported top and bottom by means of slotted lugs, and the openings are designed so that the grids cannot drop out but must be raised when removed. To replace a grid, it is only necessary to loosen the nuts of the supporting rods, when the grid can be removed and a new one inserted without the use of additional material.



Grids are easily replaced.



Combination sweeper, plow and locomotive in use by Ottawa Street Railway Co.

New Sweeper for O. E. R. Co.

The accompanying illustrations show a new all steel frame combination sweeper and snow plow recently built for the Ottawa Electric Railway by the Ottawa Car Company. The underframe of the new car is very rigidly constructed with 10-in. channel steel and strongly braced with lateral bracing. The cab is built of wood with steel panels.

This new car has several improvements over the sweeper which was built for the same company in 1912, these being (1) detachable ends by which means the brooms can be taken off or put on as required, (2) plows raised with worm and worm gear instead of the chain and drum gear, and (3) instead of having two large sliding doors which were located on each side in the centre of the cab in the former sweeper, the new car has one door near the end and a sliding sash at the centre of the cab from which the plows can be operated.

All the operating wheels for the brooms and plows are conveniently placed in the cab. The sweepers are mounted on Brill-27 F-E-2 trucks having 4 ft. 10 in. wheel base and cast iron wheels. Westinghouse straight air brakes are installed. The electrical equipment consists of four Westinghouse 101-B-2 motors mounted on the trucks and two Westinghouse 12-A motors located in the sloping steel housings at each end of the cab. These are connected to the broom shafts with Jeffrey detachable chains.

The sweeper is equipped with 2-K-35 controllers and one K-10 controller. The machine weighs when in use as a sweeper about 55,500 pounds. As seen from the illustration it can be used as a locomotive, 30-ton capacity, requiring very little ballasting.

Fort William's New Cars

The city of Fort William have recently received from the Ottawa Car Manufacturing Company, Limited, for their municipal system, four double truck all-steel frame, semi-convertible type p.a.y.e. cars. These cars are of the semi-convertible type, have an all-steel under-frame and side construction, and are fully equipped with rattan upholstered seats, pantasote curtains, Forsythe curtain fixtures, incandescent lighting system, hand brakes, draw bars, alarm gongs and other fittings standard on cars of this type.

They are also equipped with special appliances as follows: Brill No. 27-G-1 trucks with standard hot rolled steel axles and chilled iron wheels; Westinghouse quadruple No. 101-B-2 motor equipments with K-35 controllers and other accessories; Westinghouse schedule SM-1 air brakes, H. B. life guards; "O. C. Manufacturing Company" track sanders; Consolidated Car Heating Company buzzer signalling system; Peter Smith "coal fuel" hot air heating and ventilating apparatus and Crouse-Hinds arc headlights.

While the exterior of these cars up to the roof line is of steel construction to stand the wear and weather, the interior finish including all window sash and doors is of cherry, natural color, and highly polished; all interior trimmings such as sash and door locks, grab handles, etc., are of solid cast bronze, polished finish.

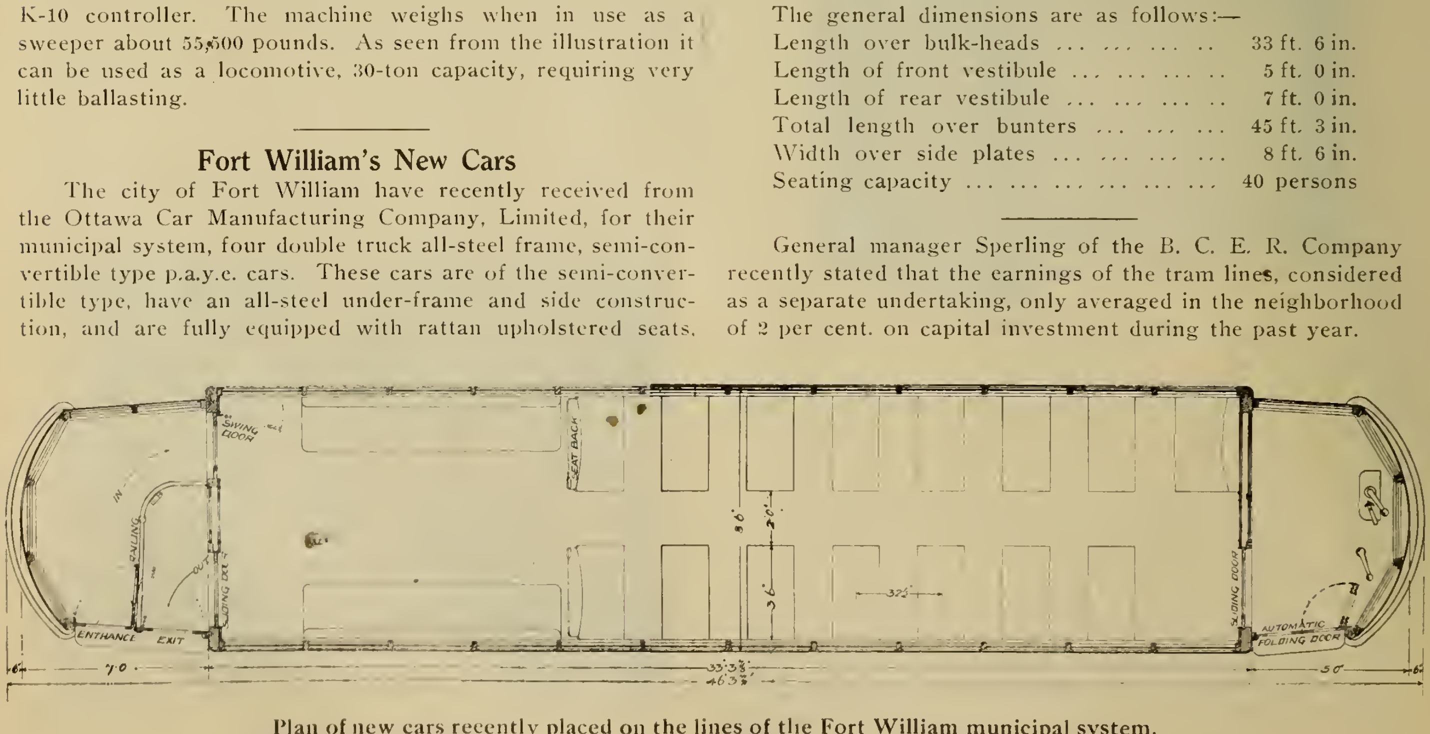
The roof is a composite wood and steel construction, monitor type, covered on the outside in the usual way with heavy cotton duck, stretched in white lead and oil paint. The interior of the roof is finished with three-ply wood veneer head-linings and painted.

On the whole, these cars are of a very high quality, and being very graceful in appearance they may be considered as being equal to any, of their type, on the continent.

The general dimensions are as follows:—

Length over bulk-heads	33 ft. 6 in.
Length of front vestibule	5 ft. 0 in.
Length of rear vestibule	7 ft. 0 in.
Total length over bunters	45 ft. 3 in.
Width over side plates	8 ft. 6 in.
Seating capacity	40 persons

General manager Sperling of the B. C. E. R. Company recently stated that the earnings of the tram lines, considered as a separate undertaking, only averaged in the neighborhood of 2 per cent. on capital investment during the past year.



Plan of new cars recently placed on the lines of the Fort William municipal system.

Illumination

Illuminating Engineering in 1913

The year of 1913 witnessed a great awakening in Canada's industrial and mercantile worlds for a higher standard of illumination in the factory and store. The interest so awakened going beyond the demand for "lots of light," to a desire for the proper amount of light, the quality best suited for that particular requirement, and the correct placing of, and treatment of, the units to eliminate any objectionable features, such as glare or other fatiguing effects on the eye.

That the continuous operation of the modern industrial plant involves a very liberal use of artificial illumination is strikingly demonstrated by reports, giving the average hours per day of sunshine, cloudiness and darkness for each month, during an entire year. Reports compiled for the city of New York during the year 1910, show the following conditions that prevailed there:—sunshine 32.3 per cent., cloudiness 19.1 per cent., darkness 48.6 per cent. With slight variations these figures will doubtless hold for any year throughout Canada's manufacturing centres.

The maximum output of an industrial plant is possible only under perfect operating conditions. No firm, however well established and prosperous, is pursuing the best business policy, if it fails to pay attention to every detail that makes for higher efficiency. To the manager who is intent on increasing the productiveness of his establishment, improved illumination means three things, more work, better work and greater safety on his operating floors; in other words, increased production, profits and welfare.

In commercial lighting rapid advances have also been made and many of Canada's largest retail establishments have, during 1913, changed their lighting systems from the old obsolete types to the newer ideas of today; this not alone promoting a better illumination but greatly enhancing the beauty of the stores, adding generously to their attractiveness.

Another field that has given recognition to the splendid work of the illuminating engineer, has been that of the church. The older types of church lighting that have caused so much eye discomfort are fast disappearing, and under the guidance of the lighting expert, installations are being made that permit of rare artistic effects, without being trying to the eye. This is also true in the lighting of the home.

Many central stations are also working along illuminating engineering lines, having established a special department to this end, or co-operating with the lighting experts associated with the manufacturers of globes and reflectors, essential in this work.

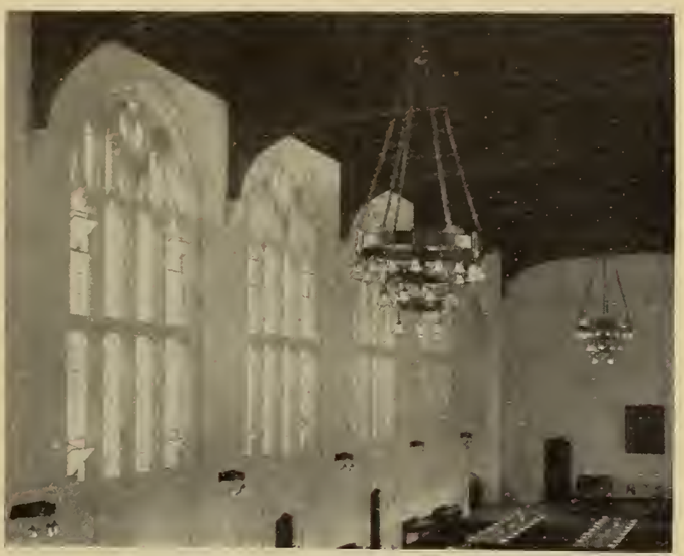
Another important recognition of the value of the work of the illuminating engineer has been by the press. Trade periodicals have devoted many pages to articles on various lightings scientifically installed, and are eager for further information in this direction.

Indications point to a larger development in the field of work for 1914 as new lamps of greater efficiency are soon promised, and the nature of this light source will make it imperative that some globe or reflector be used to diffuse its intensity and promote a greater useful illumination on the working plane.

For a field of work that is still in its infancy, and that has largely, up to the present time, been advanced by the manufacturers, to indirectly promote the sale of their materials, we can predict a big future. Great credit must be given these manufacturers for the work so far accomplished and the arousing of such interest in this comparatively new field of work. During the year tremendous advances in what might be called "specialized manufacture" have been made, so that every different requirement in the lighting field—the home, the factory, the store, the show windows, etc., is now treated independently and almost scientifically.

The Illumination of Burwash Hall

Much has been said and written about artistic electric lighting and its application to various styles of architecture, but it is noticeable that this is chiefly in catalogues of the manufacturers of lighting fixtures and there are few illustrations of actual installations one can call to mind where the ideas conceived by the architect have been carried on and out by the electrical engineer and contractor. This is largely the fault of the architect who does not lay sufficient stress on the importance of the correct design and plan of the illumination and who is often content to designate the location of the various outlets roughly, leaving the choice of design and the method of installation to the electrical contractor, whose desire to supply a correct illumination is often thwarted by a lack of foresight, both as to efficiency and effect, on the part of the designer. This is seen in the placing of outlets in the wrong positions, with too few of them and without, generally, provision for proper control. As a result there are comparatively few examples of Adam brackets, Louis XVI.



Section of main dining room—Burwash Hall.

pendants, Georgian table portables, etc., properly applied, and the application of correct practice in the illumination of a public building is specially worthy of mention.

In the illumination of the new Burwash Hall building of the University of Toronto we seem to have a rare exception in that the architects, fixture designers and electrical engineers have got together with very happy results and we reproduce some photographs which indicate not only the artistic design of the interior of this building, but the pleasing harmony which prevails throughout in the fixtures and decorations. One can see that the design of the fixtures has received the same careful attention as the design of the other parts of the building with the result that although these fixtures are striking and attract immediate attention there is nothing in them that offends one's ideas of harmony or displeases the most aesthetic eye.

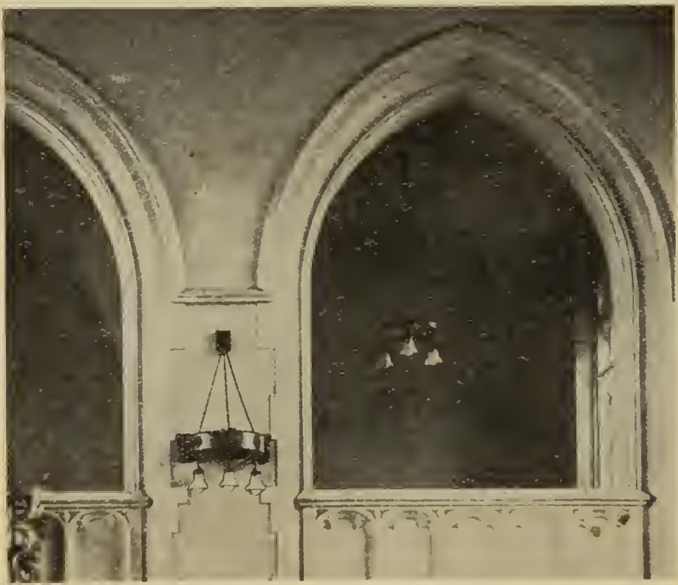
The most impressive fixtures are those in the main dining hall. Hanging from the centre are two electroliers consisting of three tiers of lights, the lights being hung by short chains from three bands of iron, diminishing from five feet diameter in the top band to two feet in the bottom, the bands being hung from each other by chains, and the whole being supported from a central corona by the same means.

The metal is of wrought and cast iron throughout, and the design is very severe, as becomes the period. The applied ornament consists of the Tudor Rose, interposed with Tudor shields, and a beading of twisted iron running round each band. Everything is designed in strict accordance with the period, even to the iron chain which is of rectangular link pattern in keeping with the rest of the fixtures.

On the walls are brackets consisting of semicircles of iron having the same applied ornament on a small scale, the lights hanging from the semicircle in the same manner as in the large fixtures.

The reflectors are all of satin finished glass, of a "bell" pattern, the lines being very simple and severe.

In the common-rooms are iron pendants of the semi-indirect type consisting of a satin finished glass dish hung in an iron band supported from the canopy by twisted rectangular iron rods, the whole being in keeping with the general design of the building.


Wall and hall fixtures—Burwash Hall.

Practically the same type of fixture is carried through all the other rooms, slight modifications only being made to suit varying heights of ceiling, etc.

As we have said before, the general impression obtained on looking through the building is that the architects and fixture designers have got together with the best possible results, and have admirably succeeded in introducing the most modern form of lighting into a building of possibly the 12th century, without any apparent anachronism.

A handsome wall bracket in keeping with the architecture.

The fixtures were selected by Messrs. Sproat & Rolph, the architects, from designs by Veritys, Limited, of Covent Garden, London, England, and were supplied and installed by Messrs. R. A. L. Gray & Company, of Toronto.

Edmonton's Telephone Extensions

The Edmonton municipal automatic telephone system has been making rapid strides during the year 1913, as will be seen by the statement appended.

The first eleven months show an increase of 2,826 phones over the previous year. The revenue for the year 1912 was $100,773, while the estimated revenue for the year ending December 31, 1913, is $195,000. The capital invested in the telephone department in 1912 was $862,074, for 1913 it will be approximately $1,800,000. Work is at present in progress on the laying of 11,100 miles of underground cable pairs, and it is expected that this will be completed in February. This big programme of work is the largest ever undertaken in the history of the telephone department and when completed there will be sufficient main feeder cables laid to take care of the districts of Norwood, Parkdale, Cromdale, Fairview, Woodland, that portion of Delton south of Delesare Ave., Eastwood, Mount Lawn, Santa Rosa, North Edmonton, Bellevue, Highlands and Virgina Park. The territory lying between Churchill Ave. and the C. N. R. tracks and the eastern portion of Glenora have also been amply provided for. These extensions are being made with a view to taking care not only of the present needs of the department but also of forming a part of the legitimate telephone plant of the city when it has reached a population of from 150,000 to 200,000. There has recently been completed in the switchboard department a 500 line addition in the north exchange, making a total of 1500 lines now available in this building. It is expected that by February there will be 1800 lines in this building. Early in March 500 additional lines will be ready for use in the main exchange and this will make a total of 5,500 in this building.

With all these lines installed and ready for service there will be a total of 10,800, or enough, it is estimated, to take care of the growth of the department during the year 1914.

The Dealer and Contractor

Get into the Bigger Field !

According to the records published by the Society of Electrical Development the salesmen of electrical supplies waste their energies in price-cutting competition to obtain a small percentage of the total business available and take no cognizance of the larger percentage of business that is going to waste for the lack of a little nursing. This is true, we believe, in the electrical contracting field quite as much as in any other line of the electrical business. The average electrical contractor or supply man waits until he hears that a certain business man has decided to install some kind of equipment or improvement, such as wiring or lighting additions. This process of coming to a conclusion is a slow one and has not been left to develop itself in any other line of trade. For example, what would we think of a life insurance company who opened an office and then sat down waiting for customers to come in and request them to place insurance on their lives. According to statistics the number of people who do this is considerably less than one per cent. of the total business written in any year. It is not easy to understand why the electrical contractor expects to do his business in a manner very much different from the life insurance company. There is a splendid unworked field in practically every town and city throughout Canada where some electrical product or other has only been sold to a very limited extent. For example, there are few sections where there are not a number of old houses waiting to be wired, and the investment of a few hours convincing the owners of the value of this modern convenience would be much more profitably spent than the present practice of cutting prices on a job of the same size in a new house. This is only one example of the line along which development in salesmanship might readily be shown.

This matter is very tersely discussed by Mr. J. T. Marron, in a recent issue of the National Electrical Contractor, who feels that there is more room for development in districts and along lines that as yet have been practically untouched. In this connection the following extracts from Mr. Marron's remarks are of interest,—

"The field for the average electrical contractor to-day is larger than it has ever been in the history of the electrical game. Statistics, furnished by the National Electric Light Association, show that there is less than one-third of the buildings in the United States wired for electric lights, and I can state without fear of contradiction that 75 per cent. of those wired are improperly lighted and no intelligent scheme of illumination has been worked out.

Now if this is true, let us analyze the contractor's field. He has 90 per cent. of the present buildings to work on for either wiring or proper illumination without touching the field of current consuming devices, which is very large and if properly handled the profits are very satisfactory.

We find that the average contractor waits for some one to come and ask him to wire an old house and then he goes out and figures it as low as possible, always assuming that his client will get another figure and will give it to the lowest bidder, and with this idea always in view he figures to put in as little as possible and never loses sight of the price end of it. The consequence is that a great many of the houess and buildings are wired improperly.

I find also that the average contractor will chase for two miles to figure on a new house in competition with ten other contractors who are after the same job, and on his way will pass fifty old houses which are good live prospects and with a little work could be gotten without any competition.

If the contractor would devote as much time in creating business as he does to figure competitive business, or, in other words, specialize and become expert in one branch of the business, knowing all that he could possibly learn about this branch instead of trying to cover the whole field promiscuously and try to figure everything that comes his way, he would be more liable to succeed in a financial way.

With the tremendous field that all electrical contractors have before them in which to work out their own salvation, there is no excuse for them not making money if they will go out and create work instead of fighting for the work already created.

I would sum up the field for the average electrical contractor as follows:

Every old house not already wired, every old building not already wired, every old building not properly wired, every good farm home for a farm lighting plant, every factory that uses power for motors, every large building for stationary vacuum cleaner, every retail store for remodeling its present lighting system and installing proper illumination, every present user of electricity for modernizing fixtures and arranging for proper illumination, the sale of mazda lamps to replace all carbon lamps, arc lamps, Nernst lamps, gas arcs and all the other kind of lights, the sale of electric irons, washing machines, percolators, toasters, fireless cookers, fans, water heaters, and all other electric devices for the comfort of the home give ample opportunity for successful effort.

You, Mr. Average Electrical Contractor, look over this field and see if you cannot spend your time more profitably selling something at your price in the field mentioned than figuring how you can take a job already created from your competitors. Wake up! Be one of the creators of business instead of one of the grabbers of low price jobs."

Canadian Krantz in New Quarters

The Canadian Krantz Electric & Maunfacturing Company, Limited, announce that they have now established a factory in Toronto which is expected to be in full operation during the present month. It is the intention to manufacture in Canada panel boards and cabinets, switchboards, knife switches, water-tight floor boxes, etc., along lines similar to those now followed by the parent company in New York. Among the products will also be a new panel known as the "safety" type, which, it is said, has met with much favor. The company are now occupying their new offices at 67-71 Adelaide Street West, where Mr. R. H. Nesbitt is in charge.

New Equipment for W. E. R. Co.

The Winnipeg Electric Railway Company have just installed twelve oil-cooled transformers of 1000 kv.a. capacity each. These transformers, as will be noted from the accompanying cut, are of the external pipe or "tubular" type, having boiler plate tanks into which a double set of pipes are welded by the oxy-acetylene process. The transformers are filled with No. 8 transil oil, which has a low viscosity, being practically a mineral seal oil, but possessing the added qualities of uniformity of characteristics and an absence of deposit even when subjected to continued excessive temperatures. The low viscosity insures rapid circulation of the oil downward through the external tubes where the heat of the oil is quickly dissipated. These transformers were supplied by the Canadian General Electric Company.

1000 kv. a. unit for W. E. R. Co.

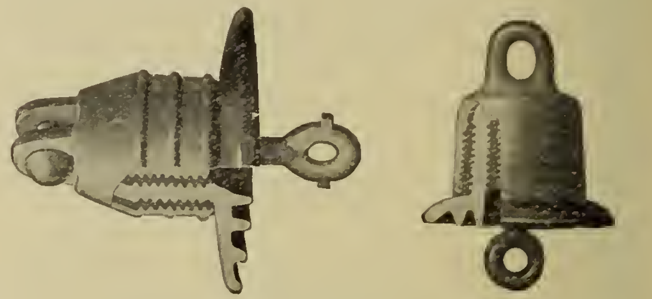
This type of tank, although new to Canada, has been quite widely used by the General Electric and other companies in the United States, and its use has extended the field of oil-cooled transformers from approximately 750 kv.a. to 2500 kv.a. Even larger units of this type could be built, but in sizes much above 2000 kv.a. the cost curve runs up sharply and, in comparison with water-cooled transformers, becomes practically prohibitive. Oil-cooled transformers above 2500 kv.a. up to approximately 4000 kv.a. can, however, be built economically by resorting to the use of external radiators (similar to the familiar steam radiator) around the outside of the boiler plate and piped to the tank at top and bottom.

The Winnipeg transformers are of Shell Type construction and are designed for service on 5500 volt circuits, six units having 22,000 volt and six having 2,200 volt low tension windings. They are provided with separate trucks and with a capillary tube dial type thermometer.

New Types of Porcelain Strain Insulators

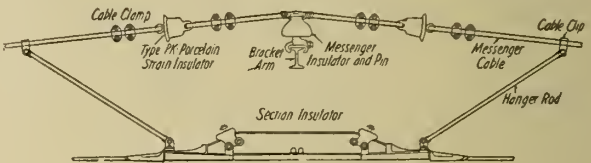
To meet the severe requirements due to the increasing weight of overhead construction, two new types of porcelain strain insulators have been developed by the Westinghouse Electric & Manufacturing Company. These are a combination of a metal cap to give the necessary strength and a porcelain skirt to furnish the required dielectric strength.

The metal parts of these insulators consist of a malleable iron cap, a drop forged steel eye bolt, and a malleable iron sleeve by which the eye bolt is securely fastened. The metal and porcelain parts are cemented together with a high grade Portland cement. The cemented surfaces are provided with carefully determined corrugations which prevent failure, except by the actual shearing of the cement. The skirt of the porcelain is provded with corrugations on the under side to give additional creepage surface.



New types of strain insulators.

Two types of these insulators are made, the PK and the PK-1. The metal parts of the type PK insulator are sherardized and those of the larger size, types PK-1, are not galvanized. The type PK insulator is especially used for insulating cables when the working load does not exceed 1600 pounds. Being tested at 5000 pounds the types PK and PK-1 are generally used for heavy service, such as dead ending high strength steel messenger cables, having a working load of 4000 and 8000 pounds respectively.



Showing uses of new insulators.

The drop forged eye bolt of the type PK-1 has side projections so that if two or more insulators are used in series they cannot swing more than a few degrees, thus avoiding the danger of breaking the porcelain skirt due to striking the cap of the adjacent insulator.

Large Number of Isolated Plants.

An estimate appearing in the current issue of the Isolated Plant states that 63 per cent. of New York's big buildings, in number, and 78 per cent. in value make their own electricity. This is the result of a canvas of 154 buildings with an aggregate value of $497,357,000, or an average of more than $3,000,000 each. The smallest building had a value of $475,000. The following classification of the percentage of each type of buildings is interesting:—of 2 railway stations 100 per cent. have their own power plant; of 27 hotels 96 per cent.; 68 office buildings and stores, 72 per cent.; 7 club houses, 57 per cent.; 14 banks, 57 per cent.; 24 apartments, 37 per cent.; theatres, none.

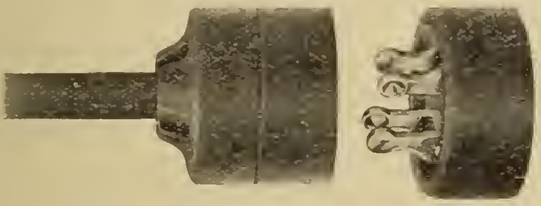
Commutator Troubles

Experience has proven that a commutator kept clean and properly lubricated will give much greater output with less heating than one which is neglected. A clean commutator prevents sparking and loss of power and increases the life of the brushes. Care should also be taken not to over lubricate as this, instead of increasing the output, decreases it by increasing the resistance between the commutator and the brushes.

Messrs. Saunders & Wainwright, 204 St. Nicholas Building, Montreal, have placed on the market a pad saturated with a special high grade compound which makes it impossible to over-lubricate or to lubricate without first cleaning the commutator. These pads are claimed to produce that desirable hard face and gloss on the commutator, reduce the friction to a minimum and ensure better contact. Another interesting line handled by the same firm is non-corrosive and non-conducting soldering fluxes. These are compounded to meet the needs of builders of generators, and are suitable for the soldering of all metals except aluminium. The Toronto representatives of this firm are the Electrical Maintenance & Repairs Company, Limited, 162 Adelaide St. West.

New Motor Attachment Plug

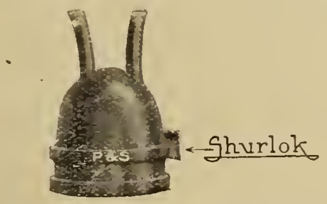
The extensive and increasing use of portable and small motor-driven devices such as vacuum cleaners, grinders, floor polishers, compressors, etc., has created a demand for a separable type motor attachment plug that can be permanently secured to the motor frame. A new motor plug recently designed by The Cutler-Hammer Manufacturing Company, shown in the accompanying illustration, is made for this purpose. The base can be permanently secured to the motor frame and this carries the rugged double lugs which are like those used on the caps of the standard line of C-H attachment plugs. These contacts are dead when the device is not in use, while the live contacts of the part attached to the flexible cord are sunk in below the surface.



A new motor plug

Rugged heat-resisting "thermoplax," having proven itself adapted for plugs, is used in the construction of this plug which has the high rating of 10 amperes, 250 volts. The design of the heavy double lugs and contacts permits of separating the plug by a pull at any angle, a feature which is considered of considerable advantage in separable attachment devices. The Underwriters' Laboratories have given their approval.

The illustration herewith is the first of a weather proof line of Shurlok devices being manufactured by Pass & Seymour, Inc. The socket is of their well known mica compound type and supplied with the effective method of locking the lamp now so characteristic of this company's products.



"Gang" Type of Pipe Taplets

A new type of pipe taplet has been designed by the H. T. Paiste Company, which is calculated to decrease the labor and material cost of iron conduit work in many places. They are of special value when the wires of several different circuits run for some distance in the same direction, and are controlled from the same point. Instead of using 2, 3 or 4 conduit lines all the way from the distribution box, the wires for all the circuits are carried in one conduit from the distribution box to the point where they separate. At the control point a "gang" type pipe taplet is used which will take 2, 3 or 4 switches. If desired, one or more of the openings may be used for lamp receptacles or plug receptacles.

Special "X" and "T" types of pipe taplets have been designed for the points where the circuits branch off from each other. At the first point of separtion, as shown in the sketch, the best fitting is the No. 4193, which reduces from a 1-inch main to a ¾-inch main and has ½-inch branches. A larger similar fitting (not shown) is No. 4194, which reduces from a 1¼-inch main to a 1-inch extension and has ¾-inch branches. At the second point of separation is shown No. 4170, which reduces from a ¾ inch main to ½ inch branches. Not only is the cost of conduit and taplets on this line just about half the cost of running four separate lines of smaller conduit, but the labor cost of cutting, threading and fitting is reduced by more than half.

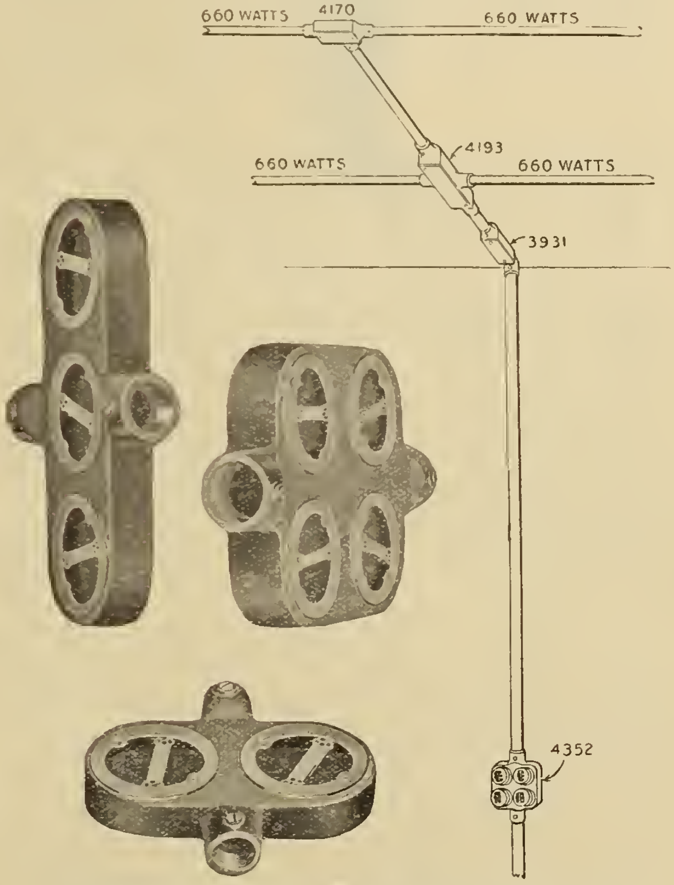


Diagram shows wires for 4 lighting circuits run in one conduit. Two, three and four gang taplets shown

The Renfrew Electric Manufacturing Company, Limited, recently commenced the manufacture of small electrical appliances such as irons, toasters, disc heaters, radiators, coffee percolators, etc. The company is composed as follows:—T. A. Low, president; Dr. S. H. Murphy, vice-president; Dr. Conolly, J. A. Jamieson, and W. J. Guest, directors. Mr. Chas. E. Breckenridge is manager, and Mr. R. P. Moodie is mechanical superintendent.

New Condulets

These condulets are for use with portable telephone equipments and designed for housing telephone jacks. The support for the jack is mounted on a gasketed metal cover, from which it is properly insulated. When the plug is removed, a lid automatically closes the opening and prevents the entrance of dust, moisture or insects.

Type "TJ" condulet is intended for use under the body of a railway car. It has a swivel base which allows the plug to pull out easily when the car is moved. An insulating bushing is provided, through which the wires pass to the interior of the car.

Type "TJD" Condulet.

Type "TJD" condulet is intended for mounting on poles or buildings along the right-of-way of a railroad, transmission line, canal, etc. The line wires enter the condulet through a ½-inch Obround 2-wire hole porcelain cover.

These condulets are manufactured by the Crouse-Hinds Company and take either the Northern Electric or the Stromberg-Carlson jacks.

Miscellaneous

The corporation of the city of Calgary have awarded a contract to the Swedish General Electric Limited, through their Canadian agents, Messrs. Kilmer, Pullen & Burnham, for a motor-generator set comprising one 1500 h.p., 2200 volt, 3-phase, 60 cycle, 400 r.p.m. auto-synchronous motor with direct connected exciter connected by means of a flange coupling to a 1000 kw., 600 volt, compound wound, inter-pole type, d.c. railway generator. This set is an exact duplicate of the one supplied by the same company early last year. The contract includes the erection of the apparatus and all necessary cables from the motor generator set to the switchboard.

Mr. G. M. Gest has finished the two contracts for building conduits for the Montreal Electrical Service Commission. The commissioners are working on plans for other conduits, but no contracts will be given out until the spring.

Trade Publications

Wiring Material—Illustrated catalogue and price list of standardized wiring material manufactured by the H. T. Paiste Company, Philadelphia.

Modern Switchboards—Catalogue issued by the Canadian Union Electric Company, Limited, 122 Wellington St. West, Toronto. This catalogue is splendidly illustrated and covers the field of switchboards under the headings low tension, mining, high tension, desk pattern, etc., very completely.

Wires and Cables—A handy vest pocket, leather bound booklet issued by the Canada Wire & Cable Company, Limited, Toronto, being a catalogue and handbook of electrical wires and cables. This booklet contains a quantity of useful tables and information which the electrical man will find very useful to have constantly by him.

1914 Diary—The Siemens Company of Canada, Limited, are distributing a very handsome diary for 1914. This diary is a handy pocket shape with pencil attached and is bound in an attractive red morocco. In addition to the diary proper, the booklet contains a quantity of interesting illustrated information regarding the varied products of the Siemens Company.

The Simplex Manual.—On the press, for the Simplex Wire & Cable Company, Boston, is a 92-page booklet, which "just fits the pocket" as well as, it is claimed, the needs of every electrical man who has anything to do with wiring problems. It is full of tables and other information of different kinds about insulated conductors and other matters electrical, and is equipped with an unusually complete index.

New Companies

La Compagnie Electrique de L'Epiphanie Limitee.

Compagnie Electrique de Sainte Edwidge Limitee, St. Edwidge.

La Compagnie de Telephone de Windsor of Windsor Mills, Que., has been incorporated.

Electric Patents, Limited, has been incorporated with capital $10,000 and head office Vancouver.

The Western Cedar Pole Company has been incorporated with capital of $50,000 and head office Calgary.

The Two Miles Falls Water Power Company is seeking incorporation. The head office will be in Sherbrooke, P.Q.

The Metropolitan Electric Company, Limited, has been incorporated with capital $10,000 and head office Vancouver.

The Beaver Coal & Power Company has been incorporated with head office at Montreal and capital $1,000,000. The incorporators are F. H. Markey, W. W. Skinner, G. G. Hyde.

The Caughnawaga Light, Heat & Power Company, Limited, has been incorporated with $50,000 capital. The names of T. M. Jacobs and J. Curotte are connected with the incorporation.

Under powers of incorporation granted at Quebec, a company called the Star & Hydro-electric Company, Limited, has been formed for the purpose of carrying on business as electricians, at Cote St. Luc, P.Q., with power to develop the necessary water power for business in the counties of Soulanges and Beauharnois and to supply electric light and power to companies or corporations. The capitalization is $399,000. The company is composed of F. Wilfrid Themens, J. E. Archambault, Charles David Fagerberg, George Edward Antrobus, and Louis Phillippe Fournier, all of Montreal.

Personal

Mr. Julius G. Koppel has been appointed electrical superintendent of bascule bridges, C. P. R. system, with headquarters at Sault Ste. Marie.

Mr. C. J. Wright, secretary-treasurer and general manager of the Eastern Townships Telephone Company has resigned. Mr. Wright has been connected with the telephone business in the eastern townships for nearly 20 years.

Mr. Beaudry Leman has been appointed general manager of the Hochelaga Bank, Montreal. Mr. Leman is an engineer by profession, and at one time was a member of the Montreal Electrical Service Commission. In 1906 he was in charge of the construction work of the Shawinigan Water and Power Company, which was interested in electrical enterprises. In 1912 he entered the banking business.

Current News and Notes

Amherst, N.S.

The Canada Electric Company, of Amherst, N.S., have prepared plans for a 1,000 kw. turbo-generator set for installation at Chignecto.

Berlin, Ont.

The Hydro-electric Power Commission of Ontario have notified four rural districts that the cost to them of 50 h.p. of electric energy would be as follows:—St. Jacobs, $29.08 per h.p.; Conestogo, $36.59; St. Clements, $42.68; Floradale (40 h.p.), $51.57. These municipalities would be served from Berlin.

Barrie, Ont.

A by-law was passed on January 5 authorizing the construction of an electric railway to connect Barrie with Michurst on the C. P. R. and give local street railway service.

Brantford, Ont.

Following the legal disputes over the Brantford Street Railway system it is understood that general manager Kellett, of the Lake Erie & Northern Railway System, has made an offer to purchase and operate the Brantford Street Ry.

During the next year debentures to the amount of $104,611 will be issued to pay for the electric construction work at present under way.

Calgary, Alta.

The city commissioners have closed a contract with the Bowness Estates Company under which the latter agree to supply power for the operation of the Bowness line of the Calgary street railway system for a term of three years at a rate of 2c per kw.h. This will remove the necessity on the part of the city of Calgary of installing a regulating equipment at the end of this line.

Dome Lake, Ont.

The Dome Lake Mining & Milling Company have closed a contract with the Northern Ontario Power Company for the supply of 400 h.p. of electric energy. The mining company have already placed their orders for the necessary equipment. It is understood the Dome Lake directors have decided to retain their old steam plant for auxiliary purposes.

Edmonton, Alta.

On January 1, 1914, a new schedule of telephone rates became effective as follows:—single trunk lines, including one automatic phone, $40 per year; two or more trunk lines with the same number of automatic telephones, $30 per year per telephone; extra automatic telephones connecting to private branch exchange, wall type $10, desk type $13; extra manual telephones, wall or desk, $8. Rental of switchboard less than ten line, cordless type, $38.50; 10 to 20 local lines, $91; 21 to 40 local lines, $115; 41 to 80 local lines, $167; 81 to 100 local lines, $215; 101 to 150, $265; 150 to 200, $300.

Embro, Ont.

There is an agitation at this point for a supply of Niagara Falls power.

Edmonton, Alta.

The estimated expenditure for the year 1914 in the city of Edmonton includes $500,000 on extensions to the electric power plant. A new power house will probably be built and one or two new units installed in it. Considerable expenditure will also be made in the electric light and telephone departments, though this will not be as heavy as in 1913. Economy will also be practised in the street railway department, where only approximately $50,000 will be spent.

Fort Frances, Ont.

A telephone commission has been appointed consisting of Messrs. C. J. Holland, J. P. Wright, and P. A. Smith. Some time ago a contract was awarded for the installation of a magneto telephone system. This will have a capacity of three hundred lines.

Fort William, Ont.

At the annual meeting of the Kaministiquia Power Company, held in Montreal, the dividend was raised from a 5 to a 6 per cent. basis, the new rate of 1½ per cent. being payable quarterly. The company was authorized to issue $200,000 new stock at par.

A by-law will be submitted authorizing the raising, by debentures, of the sum of $90,000 to improve and extend the municipal telephone system.

The municipal department of Fort William and Port Arthur have made a temporary arrangement for the operation of a through service between the two cities just as in the past when the two systems were under one management It is arranged that cars and crews will be run through but fare boxes will be changed at the boundary. It is provided that if, in the regular schedule time of operating this through service, cars should be detained longer in one city than in the other, that city in which cars are detained shall pay the extra operating cost. Each city is to have distinctive tickets. Wages of employees shall be the same in both cities. Power wires are to be cut at the boundary line, but switching arrangements are so made that either city can feed on to the other's line in case of an emergency.

A by-law is being submitted giving authority to raise $238,000 for improving and extending the railway system.

Forest, Ont.

The new municipal electric power and lighting plant was started up on December 23.

Guelph, Ont.

A by-law authorizing expenditure for street railway improvements and extensions carried. This will include the purchase of two new cars.

Goderich, Ont.

Niagara Falls power was turned on December 29 in Goderich, the power line being run out from Stratford through Seaforth. At the present time Goderich's equipment consists of three 250 kw. transformers, 26400/2300 volts.

Hull, Que.

The Hull Electric Company have just placed an order with the J. G. Brill Company covering four pairs of trailer trucks.

Hamilton, Ont.

The Otis Fensom Elevator Company have submitted an estimate on the cost of constructing an incline railway at the head of Sherman Avenue. The estimate is in the neighborhood of $250,000.

A by-law authorizing the expenditure of $335,000 for electric extension work was carried.

Engineer E. J. Sifton has issued a report on the progress of the hydro-electric system during the year 1913, which shows that the number of customers has increased from 1,231 to 7,095 with a total connected load of 10,378 h.p., not including the Beach waterworks. In the course of his remarks, Mr. Sifton states that this business has been obtained on approximately a 4½ per cent. basis, the average cost per residence and commercial contract being about 36c each and the average cost of connected load in power being about 45c per h.p., these figures including the proper proportion of office expense in addition to solicitors' salaries.

Humboldt, Sask.
A by-law to expend $20,500 for electric light distribution extensions was recently carried.

Halifax, N.S.
The Woodside Sugar Refinery Company are installing a very unique electrical plant which is claimed to be the first sugar refinery plant in the world driven entirely by electrical power, the only steam driven machinery in the whole installation being two auxiliary pumps. An isolated plant is also being installed comprising three Westinghouse 937.5 kv.a. bleeder type turbo-generators. The complete electrical installation is in charge of John Starr, Son & Company, electrical engineers and contractors, Halifax, N.S.

Havelock, Ont.
The ratepayers recently voted a by-law authorizing the council to purchase power from the Hydro-electric Power Commission of Ontario.

Kingston, Ont.
The Kingston, Portsmouth & Cataraqui Railway Company have awarded a contract for the supply of steel rails to be used on King and Princess streets, to the United States Steel Products Company, delivery to be made by March 1.

Kamloops, B.C.
The city of Kamloops have succeeded in disposing of their debentures at a rate satisfactory to the council and will proceed with the construction of their hydro-electric plant as soon as the weather will permit.

Lake Megantic, Que.
Tenders were received up to January 5 for the construction of a concrete dam in connection with the municipal hydro-electric plant. Mr. E. A. Evans is the engineer-in-charge. Tenders for machinery will be called a little later.

Larder Lake, Ont.
The D'Or Huronia Company are reported to be preparing plans to develop a water-power plant in the neighborhood of Larder Lake which will enable them to operate their mine and mill on a larger scale.

Laprairie, Que.
The town of Laprairie have installed eighty-five tungsten lamps for street lighting and will also supply current for house lighting purposes. The town is being supplied by the Montreal Light, Heat & Power Company.

London, Ont.
A by-law authorizing the operation of Sunday street cars was carried in London by a large majority.

The city is now supplying the London Street Railway System from a motor-generator set recently installed. As the railway company will eventually take in the neighborhood of 1,000 h.p., this is an added possibility of reduced rates in London.

Lake Beauport, Que.
A telephone system was recently inaugurated in this place connecting the parish with the city of Quebec.

Montreal, Que.
An application by the medical men of Montreal to the Railway Commissioners complaining of the discontinuance of reduced tolls by the Bell Telephone Company was dismissed. The doctors had been allowed a special rate of $40 per annum, against a rate of $55 for business telephones.

The Quebec Legislature have declined to ratify an agreement between the municipality of Pointe aux Trembles and the Montreal Tramways Company granting the latter a forty years' franchise.

The new year has opened in a somewhat disappointing way for Montreal electrical contractors, work being perhaps 25 per cent. below the normal. The dullness is, of course, more marked owing to the exceptionally brisk business in 1913, which resulted in many new firms starting.

With a view to giving the employees an interest in the company, the Montreal Light, Heat and Power Company have issued 1,000 shares at par—(the Stock Exchange price is now round about 215)—the amount payable being spread over three years in twelve equal quarterly instalments. In case of death the payments can be continued by the executors. At the end of three years the shares become the absolute property of the employees, who can dispose of them if so desired. The shares were subscribed three times over, allotment being made pro rata in accordance with the rate of salaries paid to employees of one year's standing. It is understood that this issue of stock will probably be followed by others.

During the past season the C. P. R. Telegraph department constructed about 6,000 miles of wire and new lines, the chief work being in the west. In the manitoba division there were 1,045 miles of copper wire, 90 miles of iron wire, and 151 miles of train despatching telephone circuit. In Saskatchewan 585 miles of copper wire, 617 miles of iron wire, and 25 miles new extensions. In Alberta, 1,065 miles copper wire, 713 miles iron wire, 50 miles railway equipped with train and telephoning despatching circuits, and 250 miles of line on new railway.

The Montreal Tramways Company have purchased from the Canadian Light and Power Company a large block of land in the parish of Lachine, for the construction of yards and car barns. The purchase price was $153,175.

Nelson, B.C.
The ratepayers passed a by-law to purchase the street railway system and operate it as a municipal enterprise.

North Burnaby, B.C.
The new street car line was officially opened for service on December 23. This is an extension of the Hastings Street East line to the foot of Capitol Hill and is stated to be but one of a number of lines that will eventually give Burnaby residents better transportation facilities.

Oshawa, Ont.
A by-law authorizing a contract with the Oshawa Electric Company for power for the waterworks plant carried.

Orillia, Ont.
The annual statement of the receipts and expenditures in the electrical department for 1913 shows that the town

of Orillia has made splendid progress during the past year. The total receipts are $55,477. After paying all expenses, including operation, maintenance, power costs, salaries, sinking fund and all reconstruction and extension work, amounting to $11,140 in the past year, there is still a net balance of $2,156.

Ottawa, Ont.

The Fire & Water Committee have recommended the installation of a new fire alarm system by the Northern Electric & Manufacturing Company.

The Ottawa Electric Railway Company will require heavy steel rails for some mile and a quarter of track on Sussex and Bank streets, when, or if, the paving work is undertaken by the city.

According to the custom followed in other years the Ottawa Electric Railway Company gave each of their 600 employees last Christmas a present of $2, the money being paid to the men on Christmas eve. Prior to about three time, but as this did not particularly suit the unmarried men years ago each employee received a turkey at Christmas it was decided to give money instead.

Peterborough, Ont.

The new magnetite arc lamps were lighted for the first time on Wednesday, December 17. There are 120 lamps in the installation.

The city council have withdrawn their resolution requiring the Otonabee Power Company to remove their poles from the city streets on January 1. This hasty action on the part of the council was evidently going to inconvenience the citizens greatly. The company throughout have taken a most reasonable attitude in the matter.

Penetanguishene, Ont.

The Hydro-electric Power Commission of Ontario will be asked to prepare an estimate on the cost of an electric line connecting this town with Midland and Port McNicol on the Canadian Pacific Railway.

Parkhill, Ont.

The matter of installing an electric distribution system will be taken up at once by the new council and Mayor Harrison.

Preston, Ont.

The by-law passed granting the Galt, Preston & Hespeler Railway Company a 25-year franchise.

Richmond Hill, Ont.

A by-law to expend $4,000 on municipal electric improvements was carried.

Regina, Sask.

The following rural telephone companies have been incorporated:—Rich Prairie Rural Telephone Company, Limited, Bienfait; Thorson Rural Telephone Company, Limited, Macoun; Elstow Rural Telephone Company, Limited, Elstow.

The following telephone companies have been incorporated:—Outram Rural Telephone Company, Outrom, Sask.; Silver Lake Rural Telephone Company, Bladworth Sask.; Wilberforce Lampman Rural Telephone Company, Lampman, Sask.; Roxboro Rural Telephone Company, Griffin, Sask.

The November operation revenue and expenditure returns for the Regina Municipal Railway system was as follows:—Revenue—Car earnings, $19,225.55; miscellaneous earnings, $1,537.95—$20,763.50. Expenditure—Maintenance of way and structures, $527.86; maintenance of rolling stock. $513.87; purchased power, $5,626.52; conducting transportation, $11,593.73; general expenses, $1.315.71—$19,577.69. Balance revenue over expenditure, $1,185.81.

Operation returns for the week ending December 20, of the municipal street railway system of the city of Regina were as follows:—Revenue, $4,212.05; passengers carried, 102,085; passengers carried including transfers, 115,702. The corresponding figures for the week ending December 27 were $4,537.20; 105,864 and 117,399.

Saskatoon, Sask.

A regular service has been installed on the suburban line connecting Saskatoon with Sutherland a distance of approximately three miles. An hourly service is given from six o'clock in the morning till twelve midnight, cars leaving Saskatoon on the hour and Sutherland on the half hour. A five cent fare is charged between the city limits of Saskatoon and the Sutherland end of the line.

The negotiations between the city commissioners and the manufacturers of four new double truck cars have resulted in these being accepted by the city. They will be placed in operation at once.

Sackville, N.B.

The Eastern Development & Telephone Company which supply electric light to the town of Sackville and vicinity are increasing their rates by varying amounts in the neighborhood of 15 and 20 per cent. The matter is being considered by the Public Utilities Commission of New Brunswick.

Stratford, Ont.

Stratford's light rate in the future will be 4c per 100 sq. ft. plus 4c per kw.h., the latter being a reduction from 4½c. The rate for commercial lighting will be 8c per kw.h. for the first 30 hours of installed capacity or maximum demand and 4c per kw.h. in excess. The discount for prompt payment will be 20 per cent.

The total revenue of the Stratford Light & Heat Commission, estimating the last part of December is placed at $55,010, an increase of $11,638 over 1912. The estimated net profits for 1913 are $9,558 more than double the previous year's. During the past year the number of customers has grown by 318 bringing the present total to 1,556.

Strathroy, Ont.

A by-law authorizing the expenditure of $45,000 carried in Strathroy, the money to be expended on the installation of a distribution system for Niagara power. The initial rate to Strathroy will be $44.

St. John, N. B.

Mr. A. R. Gould, president of the St. John Valley Railway Company, has secured a charter for a railway across the northern part of the State of Maine, thereby connecting the present lines in Quebec and New Brunswick. The new line will be 111 miles long, and will be operated by electricity. Mr. Gould states that the power now developed along the proposed route is sufficient for the electrification of the line.

Stouffville, Ont.

A by-law submitted at the January election authorizing the purchase of the local electric light plant at a cost of $5,000 carried by a fair majority. An extra $2,000 will be expended in improvements.

Toronto, Ont.

The contract has been awarded by the Board of Control to the Canadian Allis-Chalmers for one 7½ and one 20 million gallon pump connected to C. G. E. motors.

A by-law authorizing the purchase of that portion of the Toronto & York Radial Railway System between Sunnyside and Humber River was carried.

Hydro-electric by-laws were carried in Hanover, Strathroy, Wallaceburg, Elora, Kemptville, Chesley and Tilbury by good majorities. An adverse vote was recorded in Sandwich.

The gross receipts of the Toronto Railway Company for the year 1913 were $6,056,005. Of this amount the city will receive, including track rentals, something over $1,000,000.

Taber, Alta.

A new electric street lighting system has been installed and placed in operation here. The power supply is obtained from the Canada West Coal Company.

Truro, N.S.

The municipal street lighting system consisting of tungsten clusters on the main street and single units on the side streets was recently placed in operation.

Uxbridge, Ont.

The application of the Home Telephone Company with branches in Whitby, Port Perry, Uxbridge and intermediate points to compel Uxbridge & Scott Telephone Company to give the Home Company direct connection between certain points instead of by a circuitous route has been granted by the Ontario Railway & Municipal Board. The order will not be enforced for some weeks as negotiations are at present under way for the purchase of the Uxbridge & Scott Company by the Bell Telephone Company.

Victoria, B.C.

City electrician Hutchison is at present busy installing a quantity of sub-station equipment for the extension of the city's street lighting arc system.

Vancouver, B. C.

The annual report of the B. C. Electric Railway Company to June, 1913, reflects to some extent the trade conditions in that province. The gross earnings increased $1,035,869, or about 17 per cent., but practically the whole amount was absorbed by higher working expenses, due in part to the coal strike. These expensive working conditions are said to still continue and may affect the current year's earnings. The directors hope, however, to maintain the present rate of dividend by the recently announced increase in the fares and by reducing expenses wherever possible. The total money expended up to June 30, 1913, by the company, amounts to $45,168,312. The amount paid out in interest and dividends for the year totalled $1,888,139, equal to 4.18 per cent. on the entire investment. In the past financial year the number of passengers carried was 71,973,822, an increase of 1,819,656. In the first year of operation, 1906, 12,395,582 passengers were carried.

Vernon, B.C.

The Vernon Board of Trade has petitioned the provincial government for assistance in laying a telephone cable in Lake Okanagan to serve the district on the west side of the lake. The petition states that there would not be sufficient subscribers to justify the local company in making the outlay itself but that the company would undertake to buy back the cable as soon as that part of the system becomes self-sustaining.

Wilkie, Sask.

A by-law will be submitted in the near future regarding extensions to the electric light system.

Waterloo, Ont.

The light and power rates which went into force on January 1 in Waterloo are as follows: domestic lighting, 4c per 100 sq. ft., plus 4c per kw.h with 25 per cent. discount; commercial lighting, 8c per kw.h. for the first 30 hours use of installed capacity or maximum demand and 4c per kw.h. for all added consumption, with 25 per cent. discount; power, a service charge of $1.00 per month with consumption charges of 2.5c, 1.7c, and 0.2c, with 10 per cent. discount. The rate for street lighting is $9.00 per lamp per year.

Winnipeg, Man.

Tenders are called to January 29 for switching gear and accessories for the King Street sub-station.

A disastrous fire on December 20th caused heavy damage to the stock of the Shipway Electric Company, manufacturers agents, Winnipeg.

Tenders are received by the Board of Control until January 22nd for a slip gate, slip gate lifting mechanism and other auxiliary apparatus in connection with the additions to the Winnipeg municipal electric plant.

Welland, Ont.

A by-law was submitted in the township of Crowland on January 5 to give authority to the Welland Electric Company, Limited, to erect a transmission line through the township.

Winnipeg, Man.

The new street lights along Portage Avenue and Road from the west city limits to Headingly were recently placed in operation. There are 61 arc lights in this installation installed on 30 ft. poles.

Acting on the report of the manager of the City Light & Power Department the Board of Control have recommended that the contract for meters for 1914 be awarded as follows, being the lowest satisfactory tender in each case, namely:—Packard—single-phase, 2-wire meters; Ferranti—single-phase, 2-wire meters, polyphase meters; Canadian General Electric—single-phase, 3-wire meters; W. E. Skinner, Limited—direct current meters.

Yarmouth, N.S.

A committee appointed to consider the question has recommended that a fire alarm system to cost in the neighborhood of $4.000 be installed in Yarmouth by the Northern Electric & Manufacturing Company.

View showing the big hydraulic fill dam at Lake Coquitlam, nearing completion. See descriptive article on page 39 of this issue.

A Miniature Electric Night Lamp

By Mr. T. H. Dempster*

With the advent of electric light the need for a small low candle-power lamp has been felt. Up to the present time this has not been successfully met. To fill the need of a small electric light, which could be applied to the ordinary distribution voltage and yet be of sufficiently low watt consumption to create a wide-spread use as a night light, a combination transformer and drawn-wire tungsten lamp has been developed.

It is well known that hospitals and sick rooms demand a lamp of low candle-power in order that the nurse or attendant may seek assurance as to the patient's comfort in the matter of bedclothes, ventilation, or temperature of the room, all without the disturbance incident to the operation of switches and the glare of high power lamps. There is a wide field for such a miniature lamp, however, that has been previously handicapped by the much greater total current consumption of the previously lowest candle-power lamp that has been available to be burned directly on the service voltage.

In a residence, such as the average flat or cottage, a night lamp burning in the hall, bathroom, sitting room, or at the cellar stairs during the evening or all night is a convenience to be tried to realize its value fully.

In the matter of cost of operation, a small lamp such as has been heretofore available, taking about 20 watts, would, if used as a night lamp burning 10 hours per day for 30 days, cost in the neighborhood of 50 to 60 cents per month, figured according to the prevailing rate for energy. This is a prohibitive figure for the ordinary householder, and would not tend to make universal the use of electric service during the night.

However, the device herein described will, at a cost of only a few cents per month, sufficiently light the rooms in an ordinary house throughout the night to permit a person safely passing to and fro. As an example of an average house, the installation would probably be as follows: one lamp located at each of the following places; the name and number-plate on front door, front hall, bathroom, one bedroom, and cellar or rear stairs, making in all five lamps. The energy required for the five transformers and lamps would be about 6 watts, and for 30 days at 4 hours per night would cost about 7 cents. For a 10-hour night service the cost would only amount to about 18 cents per month. Such a low cost of operation for light in so many places warrants the all night use and makes a pleasure of what would otherwise be a burdensome luxury.

The complete device consists of a miniature transformer contained within a brass shell and adapted to screwing into the standard lamp socket in place of the usual incandescent lamp. The shell carries at the other end a candelabra socket to take miniature plain or frosted lamps which are ordinarily rated at about one candle-power.

The miniature transformer is wound to operate on 60-cycle alternating current circuits of 100 to 125 volts. It is well insulated, of course, and has a shell-type laminated iron core working at moderate magnetic density. The windings operate at an ordinary current density, are separately insulated, and have a ratio of 10 to 1. The temperature rise of the transformer in operation is barely perceptible, being usually only about one or two degrees, which proves the high economy of the device. At no load the average energy taken by the transformer is about 1/5 of a watt; and when loaded with a lamp giving about one candle-power, the input is about 1¼ watts.

The device fills a long felt want for a very small light unit which can be operated alone or in groups without having to recourse to wasteful dead resistances or several lamps in series to consume the average 110 volts of the lighting circuit.

---

*Research Laboratory, General Electric Company.

Lighting Schedule for February, 1914

Courtesy of the National Carbon Company, Cleveland.

Date.	Light.	Date.	Extinguish.	No. of Hours
Feb. 1	10 20	Feb. 2	6 30	8 10
2	11 20	3	6 30	7 10
4	0 30	4	6 30	6 00
5	1 30	5	6 20	4 50
6	2 30	6	6 20	3 50
7	3 30	7	6 20	2 50
8	4 20	8	6 20	2 00
9	No Light	9	No Light	
10	No Light	10	No Light	
11	6 00	11	8 20	2 20
12	6 00	12	9 40	3 40
13	6 00	13	11 00	5 00
14	6 00	15	0 10	6 10
15	6 00	16	1 30	7 30
16	6 00	17	2 50	8 50
17	6 10	18	4 00	9 50
18	6 10	19	5 00	10 50
19	6 10	20	6 10	12 00
20	6 10	21	6 00	11 50
21	6 10	22	6 00	11 50
22	6 10	23	6 00	11 50
23	6 10	24	6 00	11 50
24	6 10	25	6 00	11 50
25	6 20	26	5 50	11 30
26	6 20	27	5 50	11 30
27	6 20	28	5 50	11 30
28	6 20	Mar. 1	5 50	11 30

Total Hours............206 10

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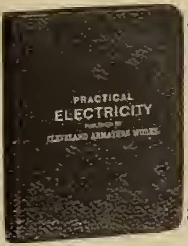

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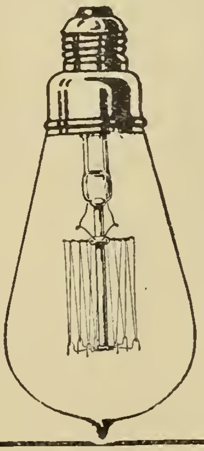
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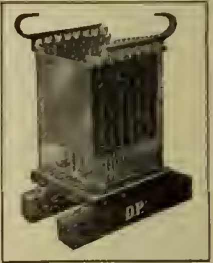

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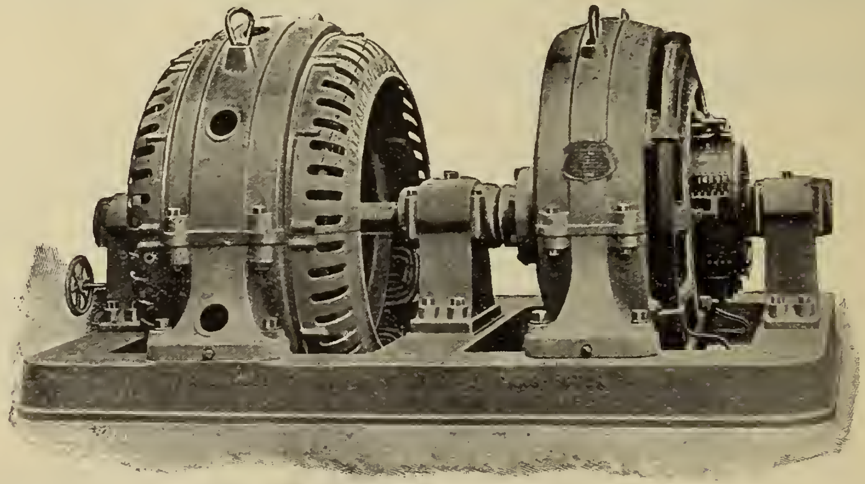

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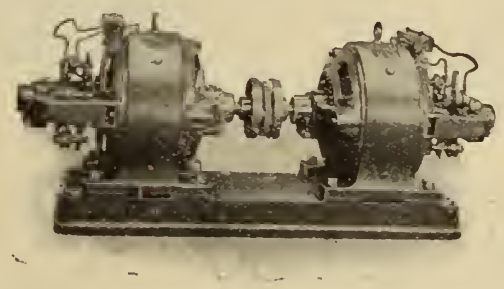

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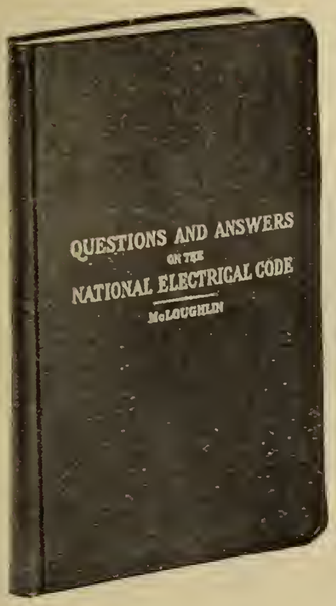

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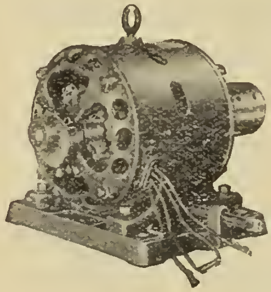

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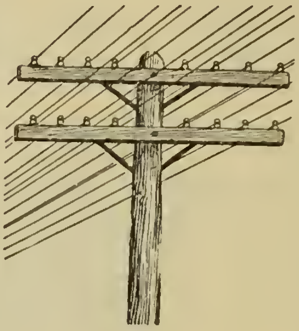

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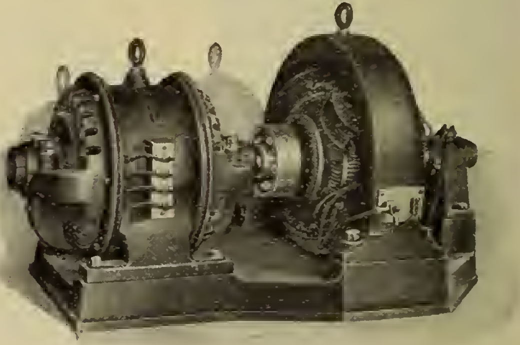

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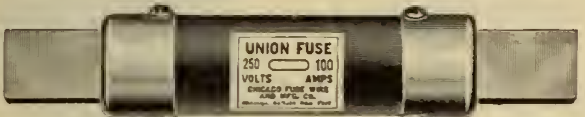

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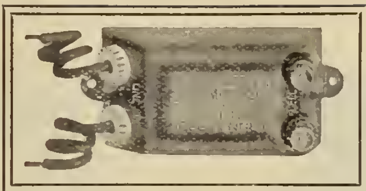

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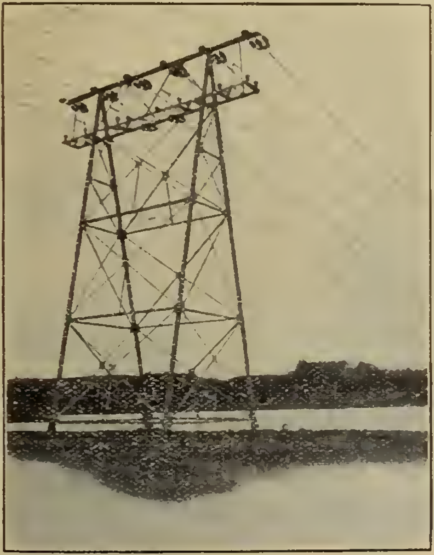

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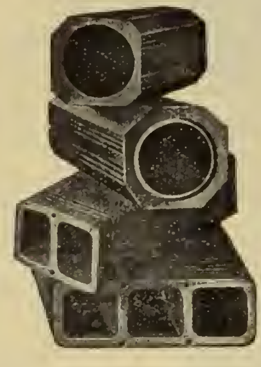

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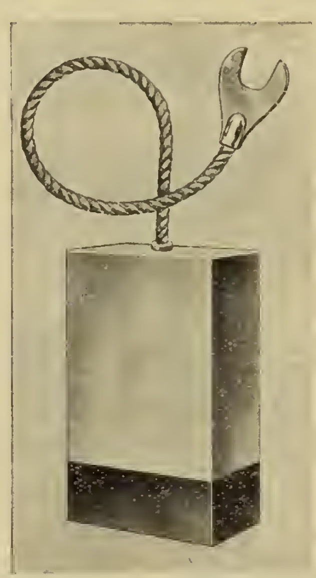

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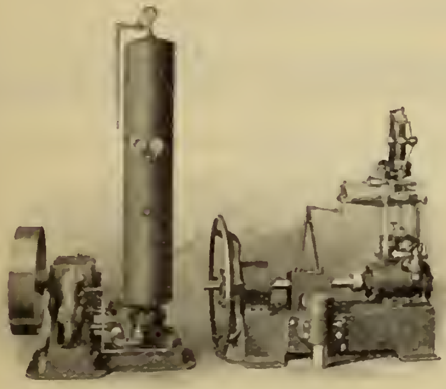

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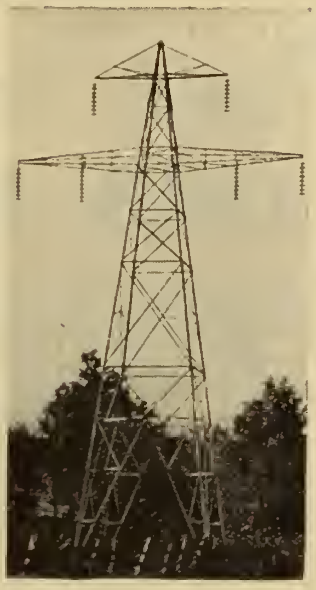

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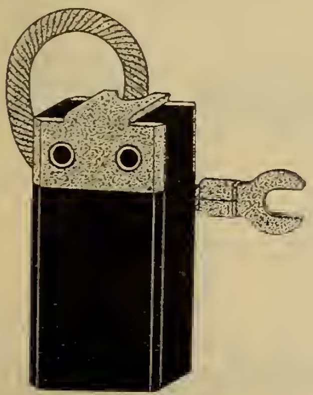

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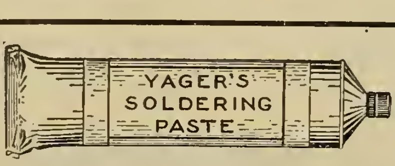

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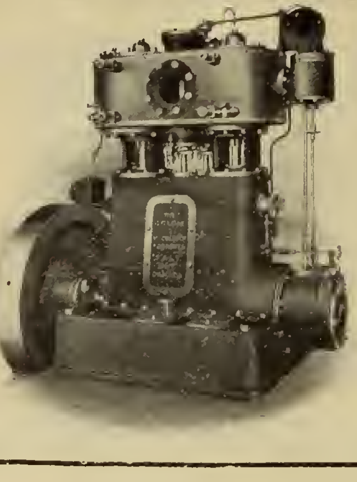

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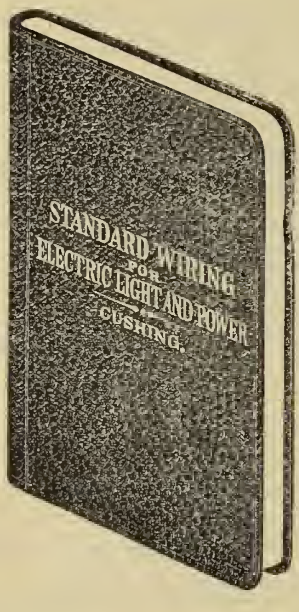

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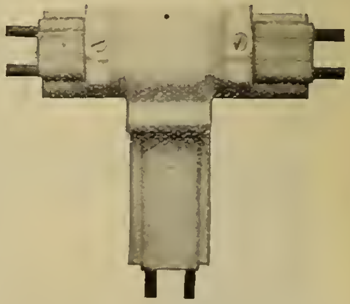

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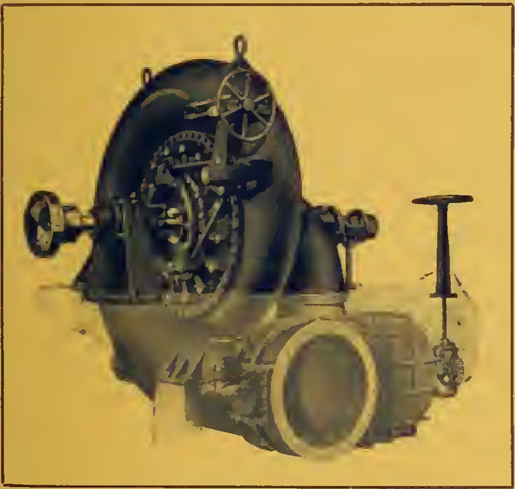

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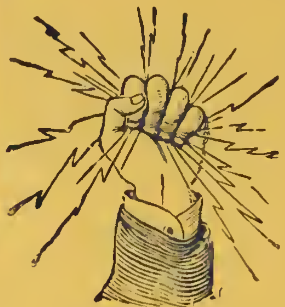

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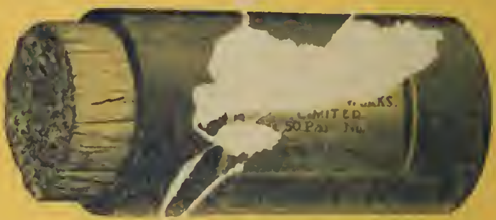

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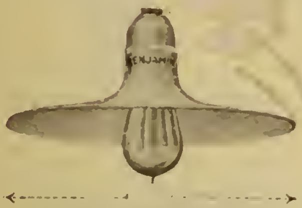

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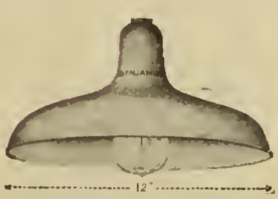

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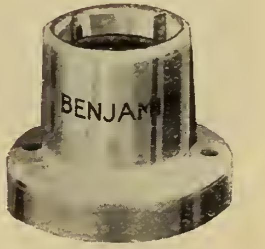

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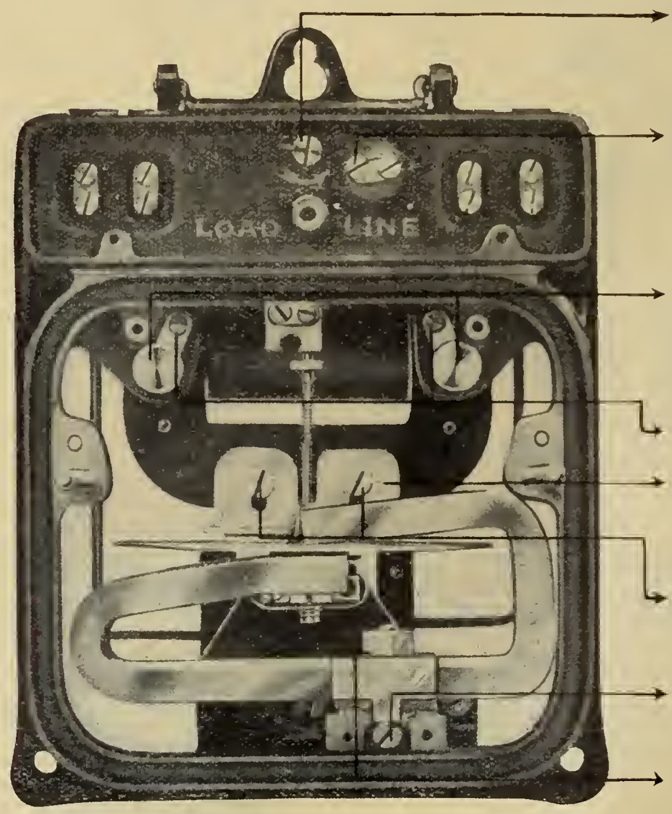

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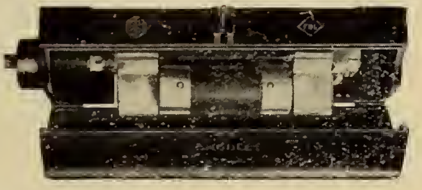

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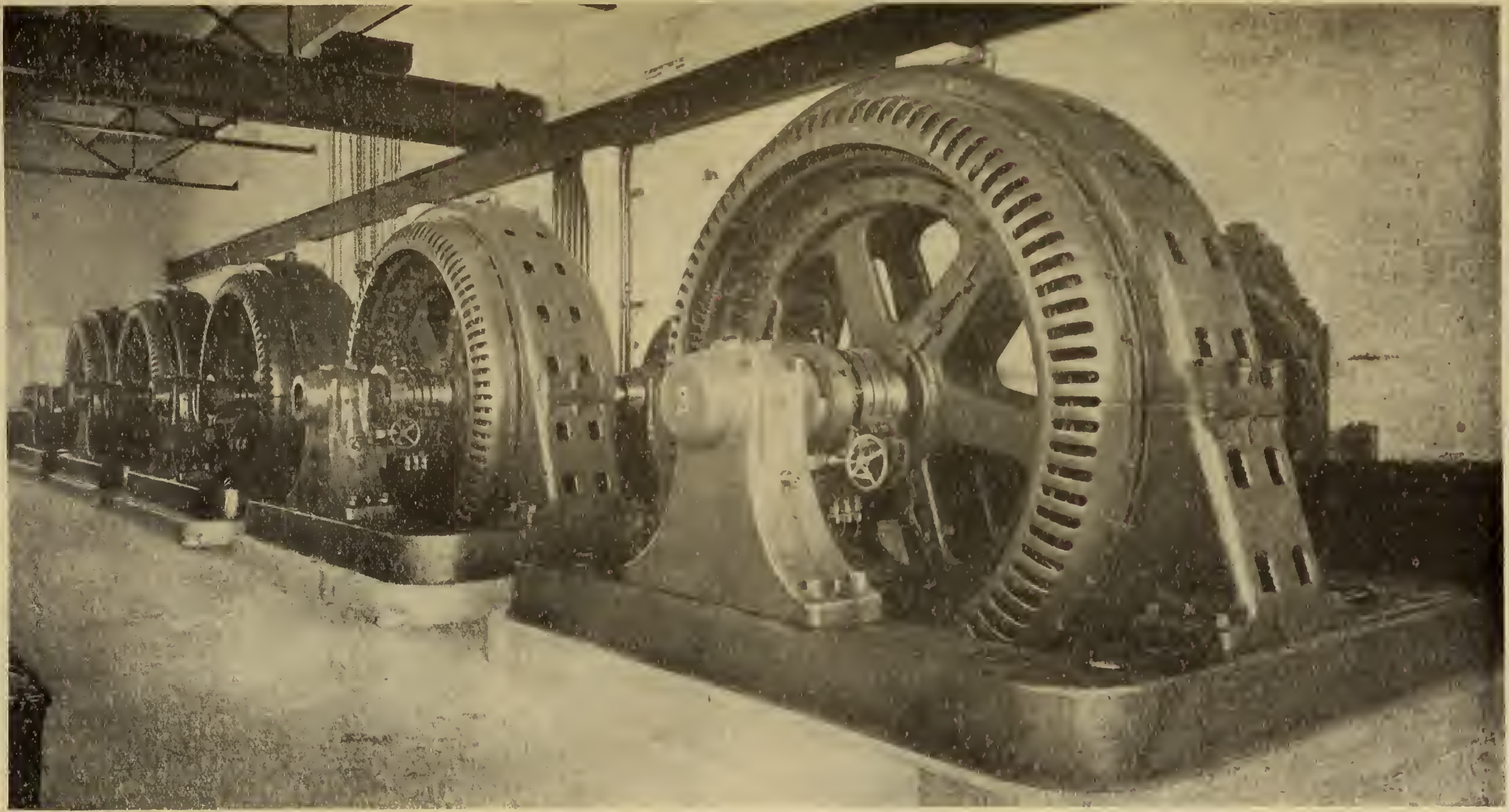

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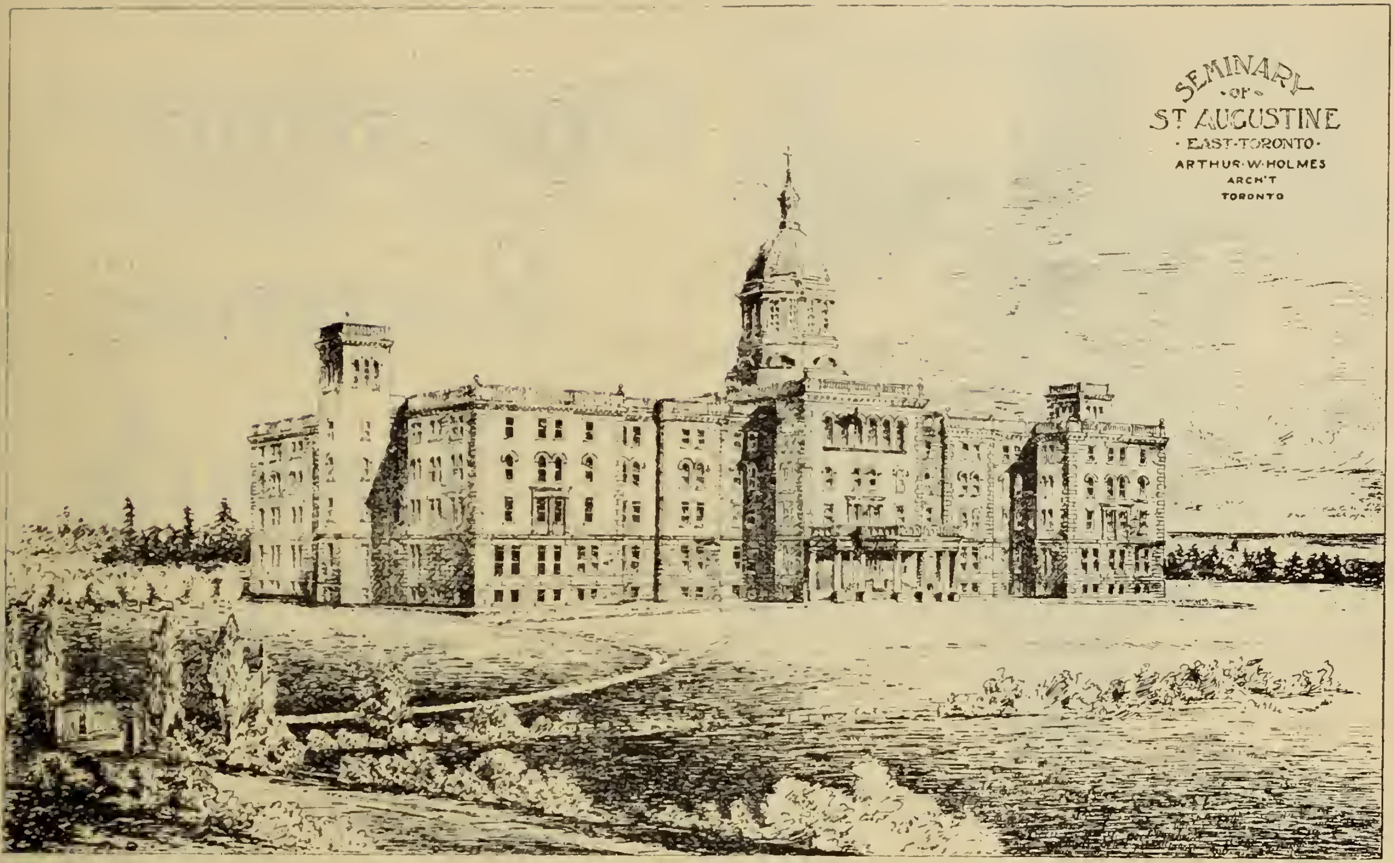

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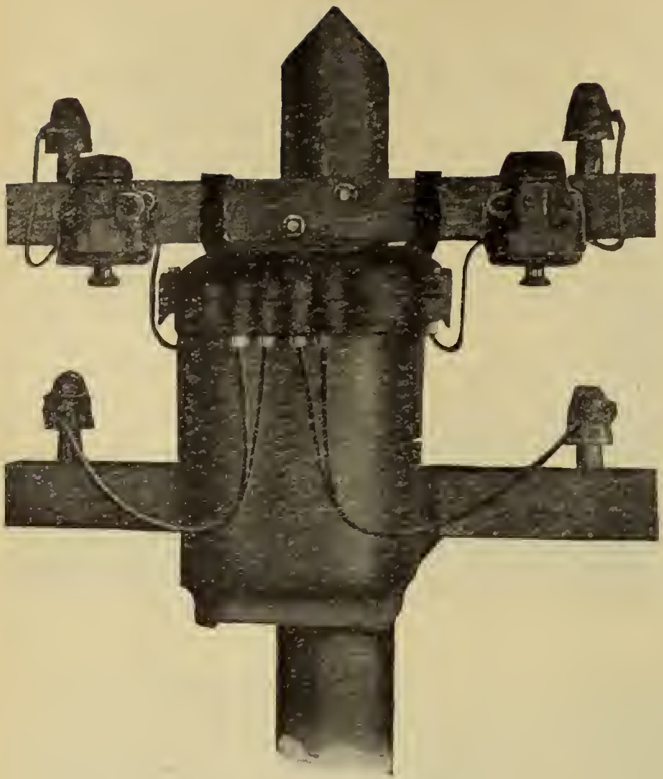

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Not the cost of purchase and installation, but the cost of upkeep and core and copper loss.

Moloney Transformers owing to the high grade Silicon Steel used in their core and to their perfect design have reduced core and copper loss to a minimum.

Moloney transformers will effect a saving of 20 per cent in one year over ordinary transformers and in five years the price of a new transformer. This is not an empty statement but a proven fact.

Send for our illustrated catalogue.

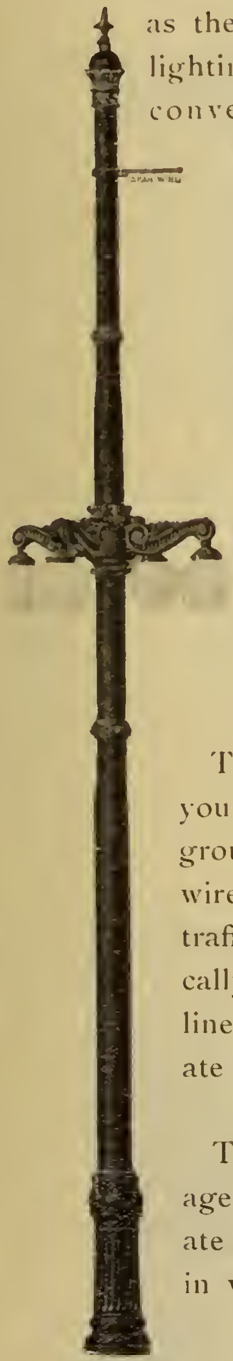
Canadian Moloney Electric Co., Limited

Windsor, Ont.

825 Vancouver Block, Vancouver, B. C., Canada
901 New Electric Railway Chamber, Winnipeg, Man., Canada
1001 C. P. R. Building, Toronto, Ont., Canada
401 Lake of the Woods Building, Montreal, Quebec.

Complete Stocks at **Windsor, Winnipeg, Vancouver**

Use the Railway's Trolley Poles



as the basis of your new street lighting system. You can easily convert them into attractive Mazda Lamp Standards or arc lamp supports by use of

ERECO Combination Railway Lighting Pole Fixtures

This system, besides saving you the expense of underground construction, gets the wires up out of the way of traffic, where they are practically unnoticeable and the curb line is not crowded with separate lighting standards.

The progressive railway management will gladly co-operate with you with this object in view.

Design No. 10015.

Electric Railway Equipment Co.
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Designers **Manufacturers**
Canadian Representatives:
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Millions of capital says "it is the best system, barring none!" This after exhaustive tests costing thousands and much time.

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TO ALL INTERESTED PARTIES

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ELECTRIC AND STEAM CAR BUILDERS

The Tillsonburg Electric Car Co., Limited

Office and Works: Tillsonburg, Ontario

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We wish to announce our readiness to tender on your insulator requirements.

Our plant is modern in every respect embodying the best European and American practice in arrangement and methods.

Our plant is in charge of experienced insulator specialists.

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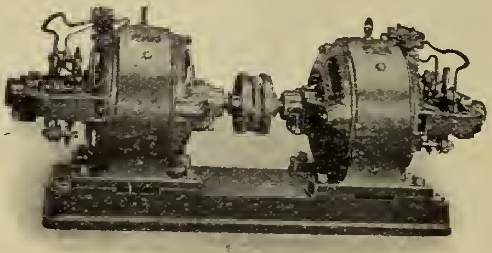
MOTOR GENERATORS

We build motor generator sets for all classes of work including low voltage sets for plating and ***special outfits*** for technical schools.



Motor generator set especially designed for Picture Theatres.

Send us your inquiries specifying full details and we will submit complete tender.

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The Mainer Electric Co., Limited
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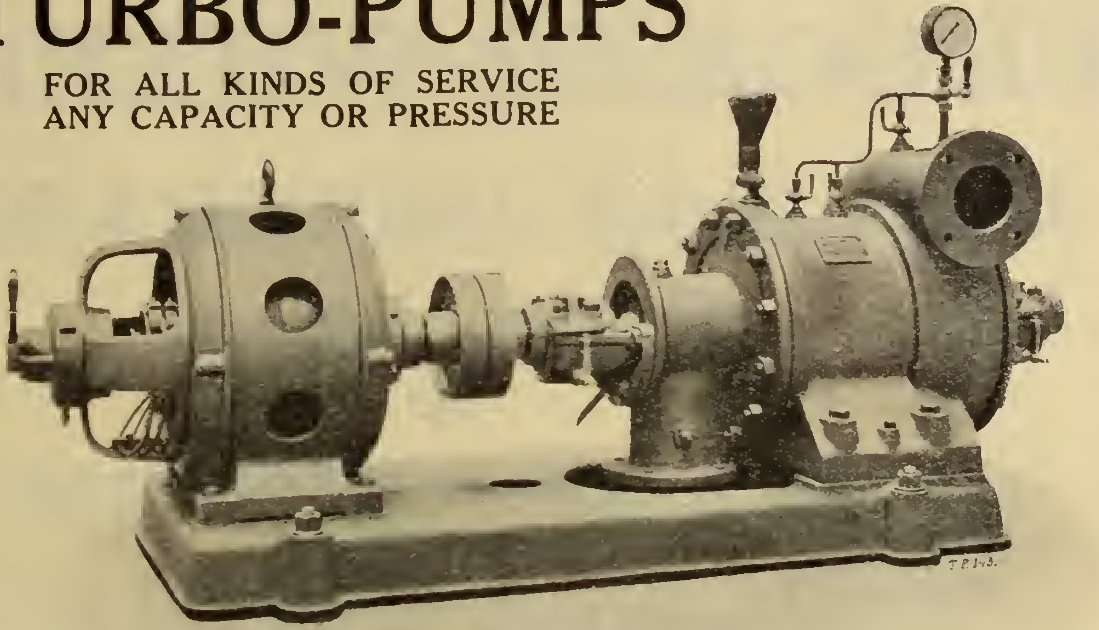
FOR ALL KINDS OF SERVICE
ANY CAPACITY OR PRESSURE

Highest Efficiency

Greatest Reliability



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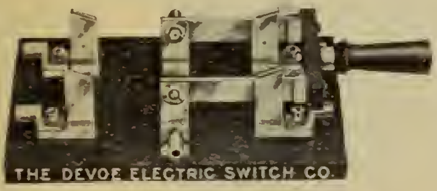
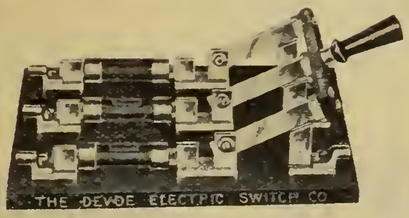
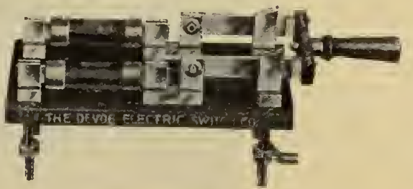
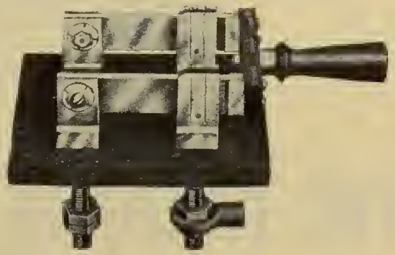
We design and manufacture SWITCHBOARDS, PANELBOARDS, CABINETS, SWITCHES and IRON BOXES of every description.

Quotations promptly made upon request when drawing or sufficient data are submitted.









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Send us your Specifications.

Office and Factory: No. 157 Craig St. West, Montreal
Frank G. Scofield, Ontario Sales Representative, Lumsden Building, Toronto, Ontario

CROCKER-WHEELER

RAILWAY GENERATORS

Engine Driven
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Motor-Generator Sets

Any Size and Speed

3,000 K. W. 80 R. P. M.

THE CANADIAN CROCKER-WHEELER CO., LIMITED

MANUFACTURERS AND ELECTRICAL ENGINEERS

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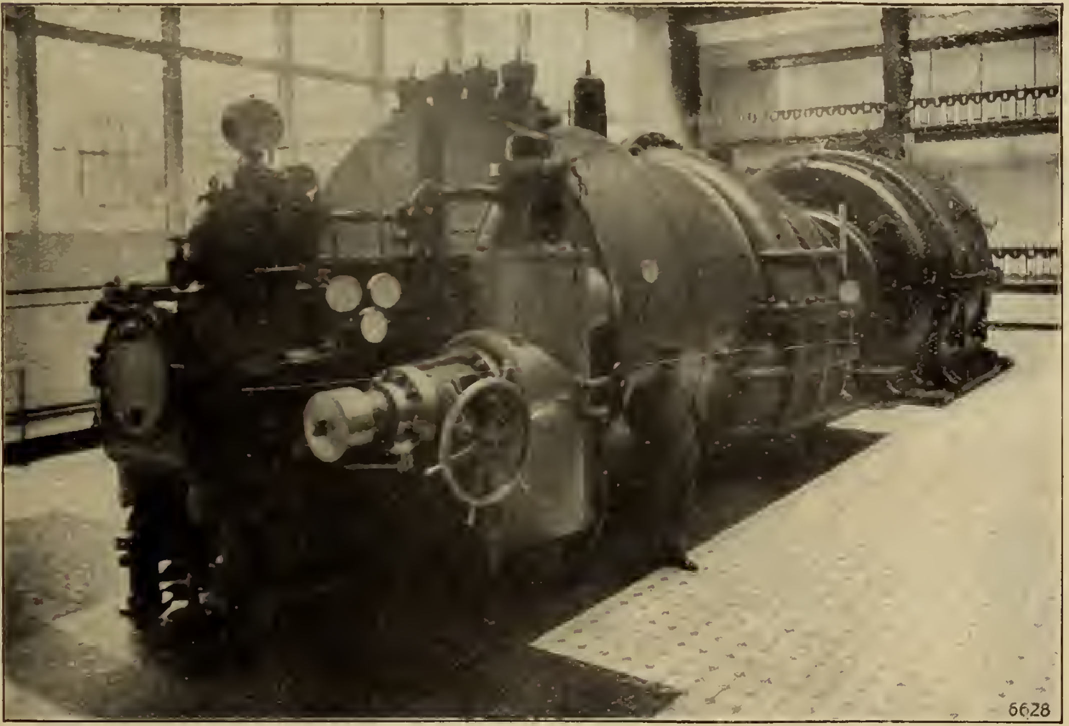
BROWN BOVERI-PARSONS STEAM TURBINES

Have World Wide Reputation.

A Total of 9,000,000 Horse Power Installed



The Largest Turbo-Generator in Operation

of 35,000 K. W. or 47,000 Horse Power

Built by
Brown-Boveri & Co. and Installed at Mark Electric Works, Westphalia, Germany.

THE CANADIAN CROCKER-WHEELER CO., LIMITED

MANUFACTURERS AND ELECTRICAL ENGINEERS

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Bound in Leather and just fits your vest pocket—the handiest little book you ever had and it's FREE.

A Free Ready Reference Book

We have just issued a vest pocket, leather bound booklet on electric wires and cables which contains much invaluable information for Electrical Engineers, Contractors, Dealers, Wiremen, etc. The book is accurately indexed and contains in tabulated form such valuable data as: properties of aluminum; comparison of copper and aluminum; resistance of aluminum; diameter of each wire in stranded cables; number of wires in stranded cables; temperature coefficients; resistance of pure copper wire; weights, etc., of weatherproof wire and cable; rubber covered wires and cables; magnet wire; office wire; annunciation wire; electric heater cord; fixture cord; weights of copper, aluminum, iron, steel and brass wires; melting point, specific gravity and relative conductivity of metals; Matthiessens standard; carrying capacity of bare and insulated wires (amperes); relative resistance of metal alloys; tensile strength of copper wires; **also complete information on insulated wires as recommended by the National Board of Fire Underwriters.**

A copy of this handy booklet will be mailed to you FREE upon request.

Drop us a card today—right now, before you turn the page over—and receive your copy before the supply is exhausted.

THIS

TRADE CANADA WIRE & CABLE CO. LIMITED CANADA TORONTO CANADA **MARK**

REPRESENTS CANADIAN GUARANTEED QUALITY

Bare and **Insulated Wires. Railway** and **Power Feeder**
Cables in **Copper** and **Aluminum**
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(Duplex Metals)
Galvanized Steel Strand Guy Wire

We can make immediate shipments from stocks carried at Toronto, Montreal, Winnipeg and Vancouver.

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CANADA WIRE & CABLE CO. LIMITED
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Double O

These **INSULATING VARNISHES** are specially prepared for us from the formulae of a large American Manufacturer of Insulating Compounds and Varnishes.

Years of experience and careful study account for their superiority. They possess high di-electric strength, retain their elasticity under extreme cold and heat, resists the action of moisture and lubricating oils, quick air drying and baking, and **THE PRICE IS RIGHT.**

ALLEN GENERAL SUPPLIES

205 YONGE STREET, TORONTO

Send us your enquiries for ;—Armature Buggys and Stands, Coil Tapeing Machines, Air Cleaners, Automatic Brake Adjusters, Car Mirrors, Controller Checks, Controller Parts, Commutators, Car Replacers, Fare Boxes, Fuses, Friction Tapes, Gears and Pinions, Gear Cases, Hydro Grounds, Illuminated Car Signs, Lightning Arresters, Overhead Material, Pinion Pullers, Trolley Bases, and Stands, Catchers and Retrievers, Varnished Tape and Cambric, Specially Moulded Insulation, Conductors' and Motormen's Caps, &c.

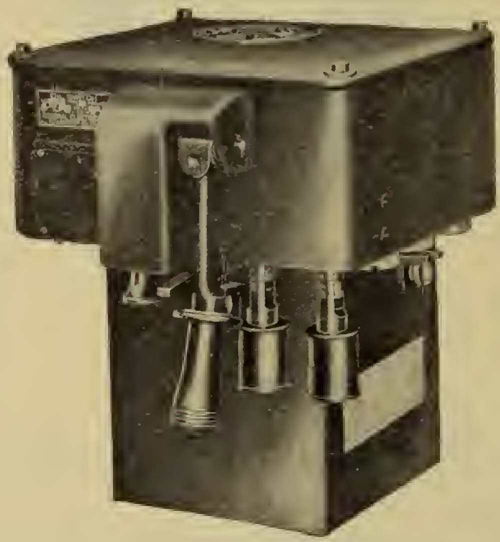
Have You Tried Perfectol Car Cleaner?

The New K 20 Oil Switch

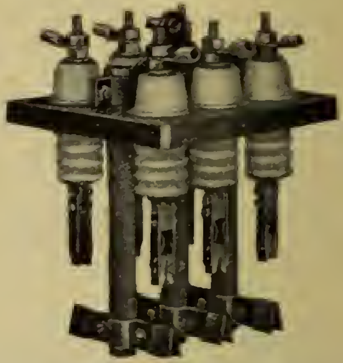
—What it means to the Plant

RELIABILITY, SAFETY AND DURABILITY

Contacts, insulation and terminals for 600-Volt Switch.



Type F. Form K-20 Oil Switch complete with automatic overload and low voltage release.



Contacts, insulation and terminals for 2500-Volt Switch.

The C. G. E. "K-20" Oil Switch was designed specially to meet the exacting conditions which are experienced in textile and flour mills, woodworking plants, powder works, coal mines, gas works, oil refineries or in any industry where there are inflammable materials or explosive gases.

It is *simple, compact* and *durable.*

It is entirely enclosed and perfect in every single detail.

Made in capacities up to 300 amperes and 2500 volts and can be furnished with different combinations of automatic tripping devices to meet a wide variety of operating requirements.

Complete information and prices are given in Bulletin 4911, a copy of which will be gladly supplied upon request.

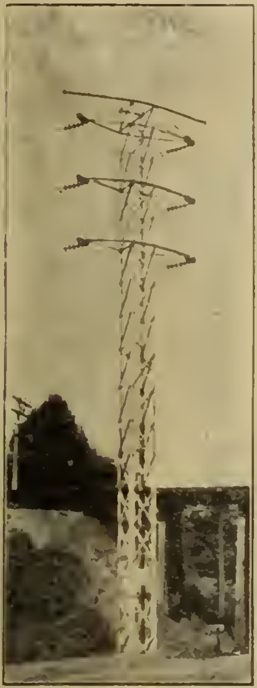
CANADIAN GENERAL ELECTRIC CO.

LIMITED

Head Office: TORONTO

District Sales Offices: Montreal, Halifax, Ottawa, Cobalt, Porcupine, Fort William, Winnipeg, Regina, Saskatoon, Calgary, Edmonton, Nelson, Vancouver, Victoria, Prince Rupert

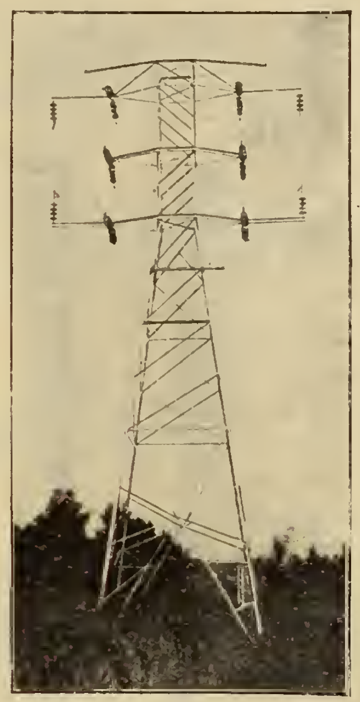
HYDRO-ELECTRIC POWER



is an economic proposition when the power plant layout and transmission system are designed on economic lines.

ALUMINIUM

for the line conductors shews an average saving of 25 to 35 per cent. over copper. Let us put put up some actual figures to you.



THE BRITISH ALUMINIUM CO., LTD.
(of London, England)
60 WEST FRONT STREET, TORONTO
Phone Ade. 3368
Cables, Cryolite, Toronto

Battery Charging Rectifier

Mercury Arc Rectifiers

Provide the ideal method of obtaining Direct Current from Alternating Current Services.

- RELIABLE AND EFFICIENT
- ALWAYS READY FOR USE
- NO ROTATING PARTS
- SIMPLE TO OPERATE
- CLEAN AND COMPACT
- NO VIBRATION

9,000 Rectifiers are used for charging electric vehicles.

Moving Picture Rectifier

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Saskatoon Calgary Edmonton Vancouver Victoria Nelson Prince Rupert

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This is the goal of every process in the manufacture of our products—it's a habit. It applies to every line of our

Electrical Supplies

TRADE DUNCAN MARK

☛ There's **your** guarantee, —the trademark which we back up all along the line.

It stands for the best of raw materials, the highest grade of workmanship and a rigid inspection before shipment.

Order through your jobber.

The
Duncan Electrical Co.
Limited
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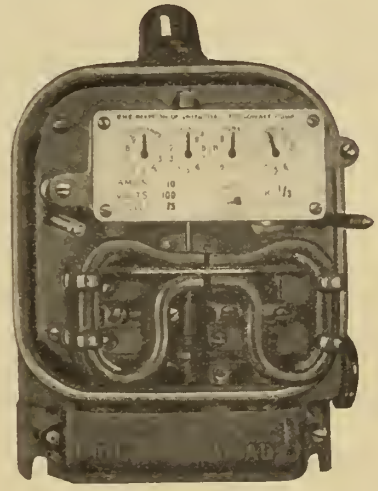
The Meter with a Reputation

Type "K" Meter

Meter with Glass Case giving clear view of interior mechanism.



Meter without case, showing improved magnet support and light load adjustment.

Large Stocks Carried at

St. Catherines and Winnipeg; St. John Railway Co., St. John, N. B.; General Supplies, Limited, Calgary, Alta.; Rudel-Belnap Machinery Co., Canadian Express Bldg., Montreal, P. Q.

The Packard Electric Co., Limited

Factory at St. Catharines, Ont.

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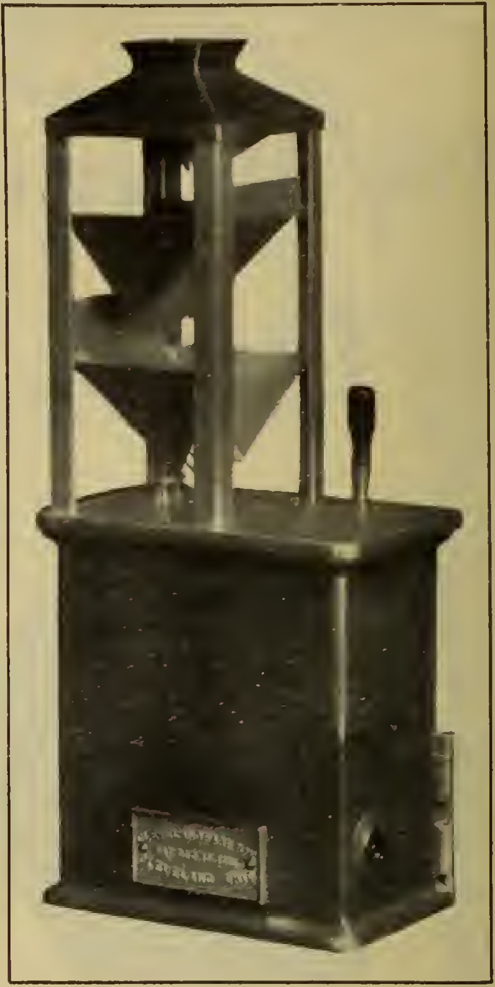
N. W. Office and Warerooms
WINNIPEG

The Safety Factor in Fare Collection



THE widespread adoption of fare boxes as a means of increasing car earnings, has demonstrated the soundness of the fare box principle.

Now, changes in general fare box design and the method of handling fares, made necessary in the light of experience, have demonstrated that there is more to the fare box idea than a collecting device.

With the Cleveland Fare Box

Safety was the starting point in the design—lightness and durability in the construction.

The fact that the Cleveland box has weathered fare box service without change indicates that the basis upon which it is built is right.

The fundamental reason for the failure of so many fare boxes to "connect," demonstrates the futility of working an idea from the top downward.

In service the Cleveland box has proven its economy from the operating and mechanical standpoint. Its maintenance is negligible.

It safeguards collections through the cash drawer, which automatically locks while being removed from the aluminum housing.

It handles tickets and cash fares, adapting itself to the requirements of both large and small systems.

The fewness of Cleveland box parts—the absence of complicated mechanism and the fact that weather conditions have no effect on the box or its parts is an assurance of continuous operation.

It will take about one minute of your time to request full information and the list of users. Use that minute NOW. It will be time well expended. Write for our illustrated catalog.

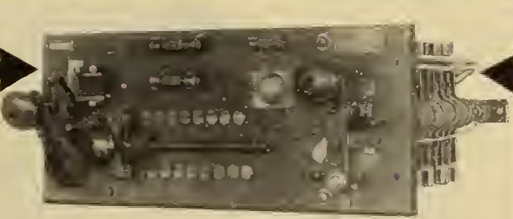
Cleveland Fare Box Company

5318 St. Clair Avenue, CLEVELAND, OHIO

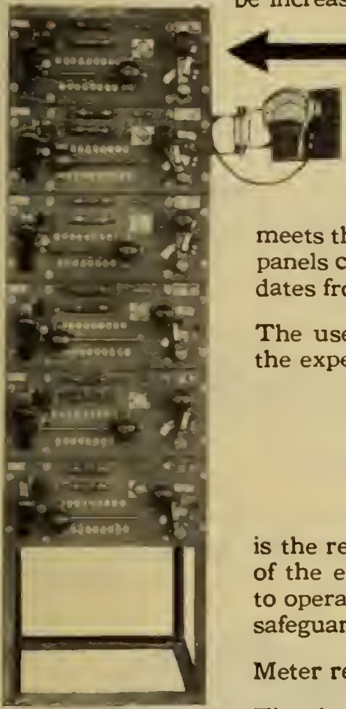
CUTLER-HAMMER

A Single Charging Unit

The Cutler-Hammer engineers have perfected the unit type battery charging equipment made up of simple complete units that can be assembled as easily as a sectional book case. Starting with one or two charging units the equipment can be increased to a hundred or more.



One of the new **Unit Type** charging sections or rheostats, 24 in. wide, 10 in. high and 20 in. deep. Each section with its resistance is a complete unit in itself and for inspection or repairs can be removed as easily as a section from a sectional book case.



Six Unit Type charging sections mounted on standard frame.

A Panel of Several Units

meets the requirements of the small garage, but it also provides for future growth. More panels can be added as needed, each one just like the original. A standard panel accomodates from one to six units, all within easy reach to be operated without the use of a rod.

The use of one meter on swinging bracket serves for a number of panels and reduces the expense of making additions. The

New Universal Unit Type Battery Charging Equipment

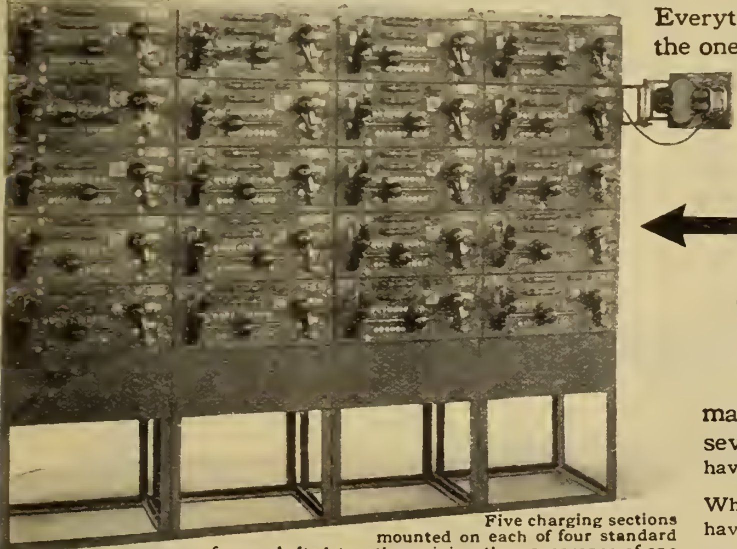
is the result of our long experience in the design of charging rheostats since the advent of the electric vehicle. It includes every desirable feature. It is easy to install; easy to operate; easy to augment; economical of current used. Every convenience—every safeguard is provided.

Meter readings may be taken at any time without opening the charging circuit.

The rheostat sliding handle is adjacent to the controlling switch and eliminates chance of error in operating wrong rheostat.

Everything for one charging circuit is complete on the one unit section front.

Batteries cannot discharge back into the circuit or into one another, should the service fuses blow.



Five charging sections mounted on each of four standard frames bolted together, giving the appearance of one complete switchboard. Another section can be added in place of blank at bottom of each panel.

A Charging Outfit of Several Panels

may be installed at one time or during the course of several years. The result will be the same. You will have a uniform equipment installed in the smallest possible space.

Whether you need battery charging equipment or not, you should have a copy of Bulletin 8530 which describes and illustrates this new Universal Unit Type Charging Equipment, the latest development of the Cutler-Hammer engineers.

THE CUTLER-HAMMER MFG. CO. MILWAUKEE

NEW YORK: Hudson Terminal 50 Church Street CHICAGO. Peoples Gas Bldg. PITTSBURG: Farmers' Bank Building
BOSTON: Columbian Life Bldg. PHILADELPHIA: 1201 Chestnut Street CLEVELAND: Schofield Building
PACIFIC COAST AGENTS: H. B. Squires Co., 579 Howard St., SAN FRANCISCO, 229 Sherlock Building, PORTLAND, ORE.
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Engineers	Mailloux & Knox	New York
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with the

Imperial Wire & Cable Company, Limited

Toronto Montreal Winnipeg

First of a series of advertisments showing buildings of national importance which have been wired with the Imperial Wire & Cable Co.'s, Limited, wires.

This picture shows

The Ritz-Carlton Hotel
Montreal

This hotel was wired with **"Imperial Higrade"** Rubber Insulated Wire.

This is the Trade Mark to look for ☛

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TRADE
HIGRADE
MARK
WIRES AND CABLES

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Northern Electric & Manufacturing Co., Limited
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"Adanac" "Imperial Higrade" and "30% Para"

Imperial Wire & Cable Company, Limited

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Conduit
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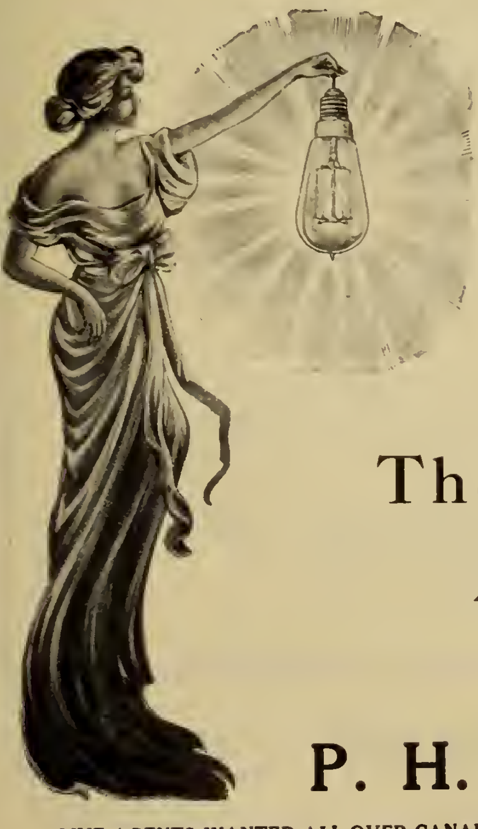

NEWTYPE
BERGMANN
LAMPS
(*Tungsten Filament*)

The Unbreakable Kind

Are Now Ready for Delivery

We guarantee delivery to you in good condition

EXCLUSIVE CANADIAN DISTRIBUTORS

P. H. KLEIN CO., LIMITED

23-25 DOWD SREET,
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LIVE AGENTS WANTED ALL OVER CANADA

When The Capacity Goes Up
The Efficiency Stays Up

The Taylor Stoker

is showing every hour and every day, in plants of all sizes, that over load capacity need not result in lowered efficiency any more than forced boilers must be accompanied by a smoking stack.

You will find the Taylor-equipped power station where boiler batteries are handling over 200 to 250% rating on long morning and night peaks, sporting boiler efficiency percentages nearer 77% than 75.

Remember 78.6% is the perfect boiler efficiency figure which, as Kent's Handbook says, is rarely if ever reached.

The reason why the TAYLOR STOKER can give efficiencies so near perfection even when driving boilers at enormous overload is because the Taylor fire's the ideal:—

A closed furnace; underfed; gravity-cleaned; air supply proportioned to the grade of fuel; and fuel gases completely burned before they impinge on the boiler tubes so that *all* the heat of the coal is effective.

"Mechanical Control of Air and Coal" will put you right on the why and how of Taylor Service. Shall we mail you a copy?

TAYLOR STOKER COMPANY, LIMITED
PHILADELPHIA

Lowered Prices

A further big reduction has been made in the prices of Nulite Mazda lamps. Below are listed some of the new prices according to our revised schedules of February 1st, 1914. If you have not one of the revised schedules we would be pleased to send you one.

Nulite Mazda Lamps

PLAIN STANDARD LAMPS

FITTED WITH EDISON BASE ONLY

Sizes in Watts	Voltage	Number in Standard Package	Standard Package Price Clear	Standard Package Price Frosted
25	100-125	100	$0.38	$0.43
40	100-125	100	.38	.43
60	100-125	100	.50	.59
100	100-125	25	.86	.99
150	100-125	24	1.44	1.62
250	100-125	12	2.39	2.57

ROUND BULB LAMPS

Sizes in Watts	Voltage	Number in Standard Package	Standard Package Price Clear	Standard Package Price Frosted
25	100-125	50	$0.59	$0.68
40	100-125	24	.59	.68
60	100-125	24	.99	1.08
100	100-125	24	1.35	1.44

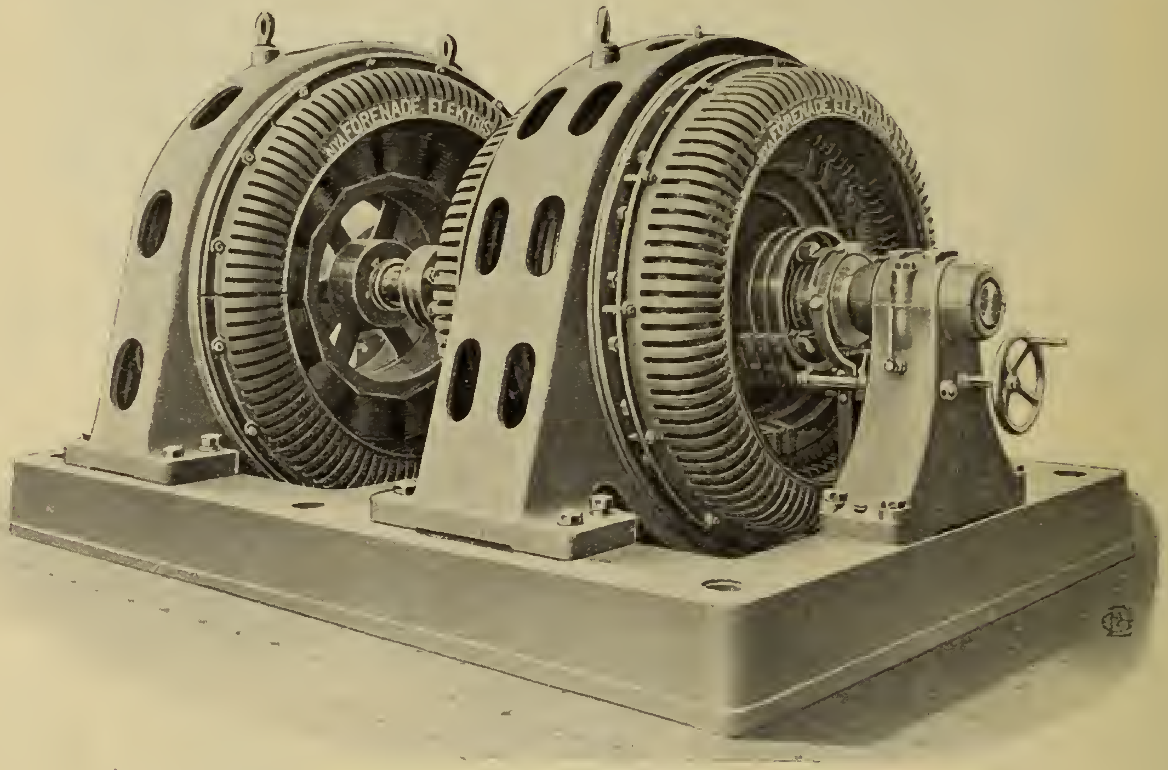
Remember that though Nulite Mazda lamp prices have periodically decreased since their introduction, their quality already "unexcelled" is steadily improving.

The Canadian Tungsten Lamp Co.
Limited
HAMILTON, ONTARIO
MONTREAL VANCOUVER WINNIPEG

Swedish Electrical Machinery

Noted for

Efficiency and Workmanship



650 K.V.A. Frequency-Changer Set; 500 R.P.M. 25-50 Cycles; 10,000-400 volts.

We solicit your specifications for Electrical Equipment

BURNHAM ENGINEERING COMPANY
LIMITED

Canadian Dealers for
The Amalgamated Electric Company of Sweden

Head Office:
Traders Bank Building,
TORONTO

Montreal Representatives:
Rudel Belnap Machinery Co., Ltd.
Canadian Express Bldg.

Rapid Meter Testing Without Interruption of Service

It's poor business policy to interfere with your customer's service when you inspect his meter.

Interruptions of this kind often mean an actual loss to him.

There is absolutely no interruption of service when you use

"NOARK" Service Meter Protective Devices

They enable you to test meters expeditiously and accurately. No delay. No uncertainty. And they positively prevent theft of current.

A complete equipment consists of a pressed steel cut-out box, interchangeable conduit and bushing plates, a meter case, meter testing block and the necessary bolts and screws for installation.

Write our nearest branch for Catalogue No. 413.

The Canadian H. W. Johns-Manville Co., Limited

Manufacturers of Service, Subway and Transformer Boxes; Fuses, Line Materials; Insulating Materials; Fibre Conduit; Fireproof Wood; Friction Tapes; Dry Batteries; Lighting Systems.

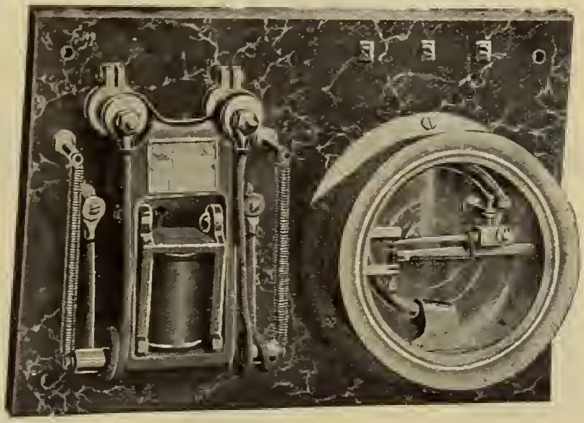
2049

J-P Co. NOARK FUSE

TORONTO MONTREAL ASBESTOS WINNIPEG VANCOUVER

Perfect Pressure Control

Can be obtained in tanks and reservoirs by starting and stopping the motor driven apparatus with



THE SUNDH GAUGE TYPE REGULATOR

The simplest, strongest and most satisfactory regulator made. Operates on a pressure difference of 3 to 5 per cent. of maximum pressure. Wider range may be obtained by screwing down the left-hand screw.

The construction consists of a silver-tipped contact lever attached to the tube and moving between two silver contact points on pressure fluctuations.

The screw on the right is used for adjusting to maximum pressure desired, and the lower screw on left hand is for adjusting for difference in pressure.

Send for "Sundh" catalogue giving complete description of controlling devices for A.C. & D. C.

Sundh Electric Company - - New York, U.S.A.

Porcelain Insulators Split Knobs

These supplies are made from the best hard white porcelain, standard sizes, at the right price.

Aside from their good quality our 5 1/2 split knobs are in strings of 25, carefully packed in strong cases. This makes counting unnecessary and goods may be re-shipped in the same case We are now taking import orders for Spring delivery. We also handle 2 wire cleats and medium split knobs.

Get our quotation from stock or for import.

Austrian Import Co., Limited

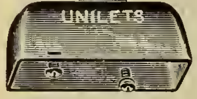
113 Youville Square - Montreal

Wholesale only.

"UNILETS"

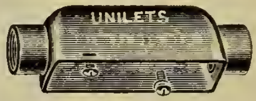
are drawn from steel and are light in weight, neat in appearance, and their durability cannot be surpassed. They are the ideal conduit fittings for up-to-date work and should be used by all contractors and those desiring their installations to be perfect in all respects. "UNILETS" are mechanically right. Furnished in either Black Enameled or Sherardized finished.

Rectangular Steel Unilets for ½" to 3" conduit inclusive

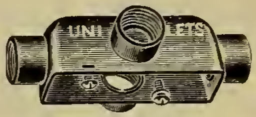


Cat. No. 9000

Cat. No. 9001



Cat. No. 9002



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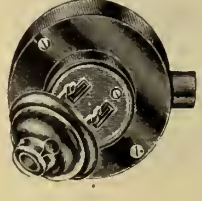
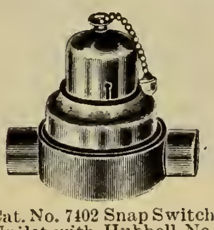
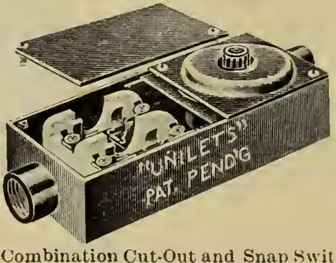
Cat. No. 9008


Type No. 1–4 inch Round Unilet with Two-phase Receptacle Attached.


Cat. No. 7402 Snap Switch Unilet with Hubbell No. 5795 Pull Switch Attached.



Combination Cut-Out and Snap Switch Unilet-Double Pole—250 volt.

Cat. No. 6906 Vapor-Proof Unilet.

Cat. No. 10 Service Entrance Unilet with No. 6003 Cover Attached.

Copy of booklet "UNILETS" sent on request

APPLETON ELECTRIC COMPANY

Main Office and Factory CHICAGO 212-214 N. Jefferson Street

For Sale in Canada by

The Mainer Electric Co., Ltd., Winnipeg — Marshall-Wells Co., Ltd., Winnipeg — Chapman & Walker Ltd., Toronto

TRADE **WALKOVER** MARK

Car Seat

gives more room, more comfort and more money-value than any other seat made.

Notice its superior construction and substantial appearance. Specify and insist on our seats for your new Electric Cars; they cost less, in the end, than the worthless imitations sometimes offered instead.

Hale and Kilburn Company

New York PHILADELPHIA Chicago

For the Man who Knows

Write for Booklet

"LE CARBONE"

(Made in France)

Carbon Brushes

It Tells You Why

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SAFETY FIRST

is only possible by using

"EVERSHEDS" MERGERS

Catalog on application

R. H. NICHOLS
Sole Canadian Agents
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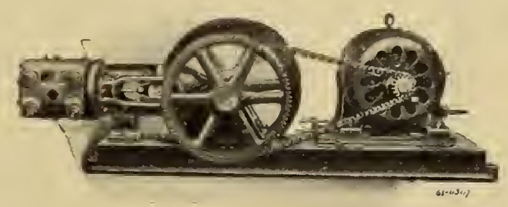


Wagner BA type single-Phase Motor, (5 horse-power, 870 rev. per min.) driving a Clayton Air Compressor.

WAGNER SINGLE PHASE MOTORS

Our single-phase standard type motor (repulsion starting, induction running) is better than ever. Our aim has been to make this the best single-phase motor of this type. Our records of the performances of these motors in service prove that we have succeeded.

When you have need for a single-phase elevator motor or a variable speed motor, consult the new Wagner bulletin 10113, then write for prices.

Wagner Electric Manufacturing Company
of Canada Limited-Montreal
27 Guardian Bldg., MONTREAL
1222 Traders' Bank Bldg., TORONTO

Member of the Society for Electrical Development—Do it Electrically.

PREPAYMENT CARS

THE proper application of Prepayment operation embraces far more than the mere pre-collection of fares. It includes also the practical elimination of boarding and alighting accidents by protecting the entrance and exit platform from the street by doors controlled from the Prepayment position.

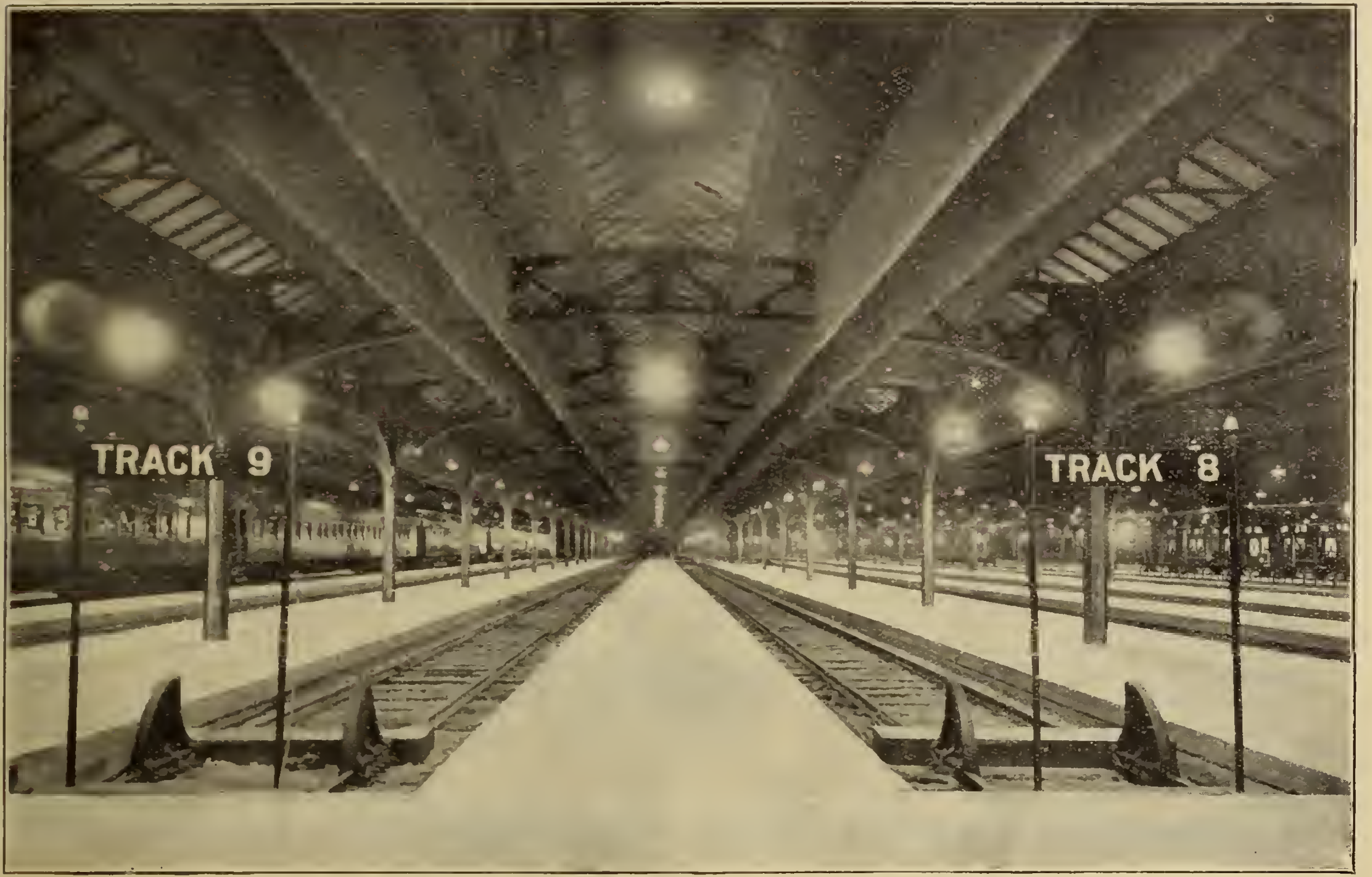
This Pay-Within idea is equally applicable to Rear Entrance, Center Entrance or Near-Side cars.

Practically every road in the United States that adopted the Prepayment idea in 1913 decided on the Pay-Within car as the ideal car for their use.

The National Pneumatic Company owns and controls the Canadian patents which cover all practical forms of Pay-Within cars, and grants a license to car builders and railway companies for the building and operation of such cars.

National Pneumatic Company

NEW YORK, 50 Church Street **CHICAGO, 515 Laflin Street**



TRAIN SHED, C.P.R. WINDSOR ST. STATION, MONTREAL.
Contractor—L. H. Neilson Company, Pittsburg, Pa.

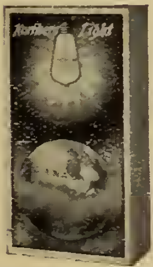
Good Lighting Pays

It would be almost impossible to find a better example of scientific lighting than that recently made in the train sheds of the new Windsor Station, Montreal.

The above illustration of that installation testifies to what you may expect from a lighting system which combines "Northern Light" lamps in their proper reflectors, scientifically arranged to give perfect illumination.

Besides "Northern Lights" which are the most efficient and economical lamps made, we can also supply reflectors to be used with these lamps, which will exactly fulfill your individual requirements.

Much of the real effect is lost in the cut shown above, but we will be glad to send you a large print taken from the original negative. Suppose you write our nearest house for this today.



THE Northern-Electric AND MANUFACTURING CO. LIMITED

Montreal Halifax Toronto Winnipeg
Regina Calgary Edmonton Vancouver Victoria

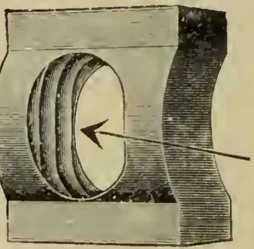
GRIP NUTS

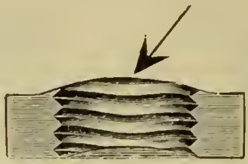
Why Grip Nuts Lock

Each bar of steel has an arch running through the center of it. The nuts are blanked out and threaded through this arch, after which they are accurately gauged, then deflected by pressure upon the crown of the arch by automatic machinery, thus producing a locking friction upon the threads, as shown in the illustration. Cut No. 3.

All Ready to Wrench in Place

They are all ready to wrench in place and will lock upon a bolt as soon as all the threads of the Grip Nut are engaged. **They do not require to be jammed or sprung.** Good contact is all that is required and they are guaranteed not to injure the bolt threads.





Endorsed by Leading Railroads

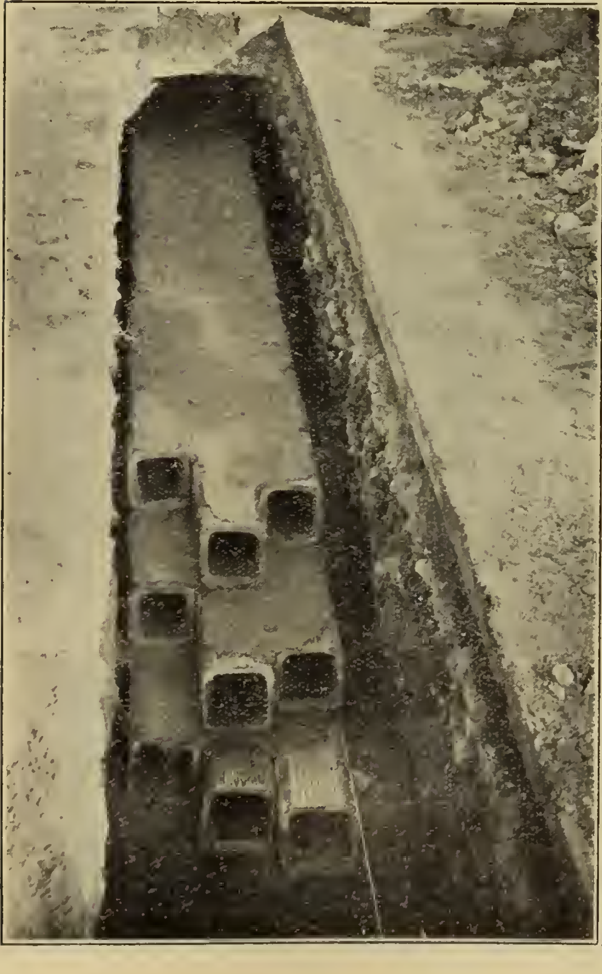
Grip Nuts are standard upon some of the leading railway systems of the United States, as well as with most of the important crossing, frog and switch manufacturers and car builders of this country.

Can be Applied to any Bolt and Will not Injure Threads

We have engineers in all parts of the Dominion who will call upon you on request and explain the wonderful efficiency of this device, its saving, etc. We also make a holding nut that does both the holding and locking.

Canada Grip Nut Company, Limited

Head Office, 263 St. James St., Montreal **Works, St. Johns, P. Q.**



This is
the kind of Conduit
installation you
get when

Dietrich
LIMITED

are the
Contractors.

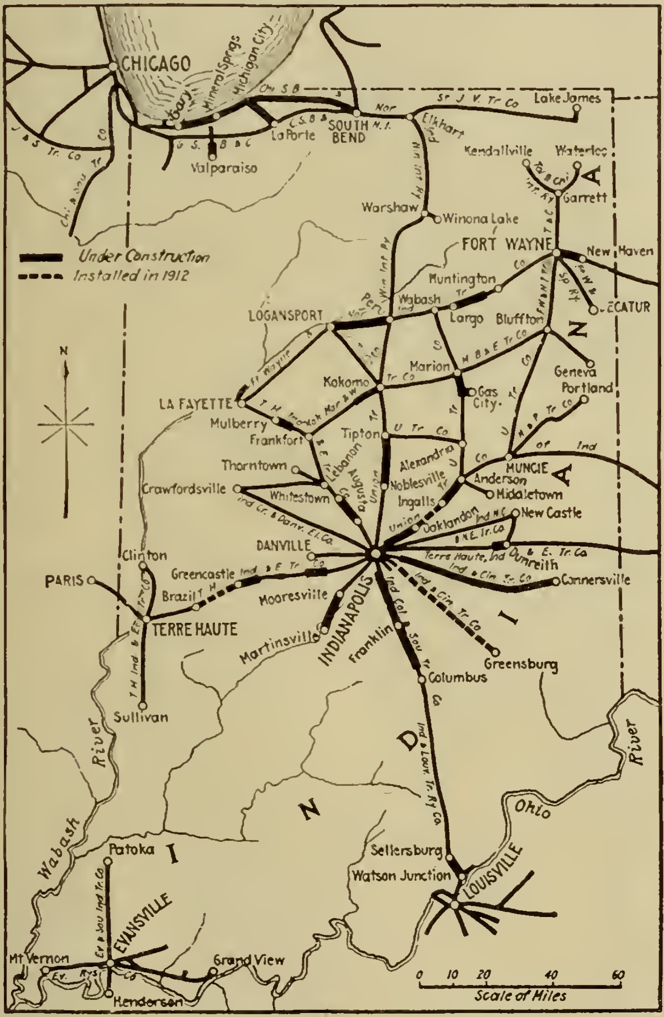
No trouble pulling cable here.

Let us have an opportunity to tender on your next job.

300 Read Bldg., MONTREAL

The Successful Operation of Any Installation of Block Signals

depends almost entirely upon the care and attention given to the signaling layout and the installation



Indiana Signals — Map Showing Protected Sections of Track Existing and Under Construction.

I am fully equipped both by reason of experience and assistants, to act as your engineer in the study, design and installation of any block signaling, automatic train control, interlocking, or highway crossing protection in which you may be interested.

I have been closely affiliated with the work of the several interurban roads in Indiana which have installed block signals and have acted as their consulting engineer for the last two years.

My experience covers a period of sixteen years in the design, construction, maintenance, operation and supervision of **all classes of signaling work.** I have served the Interstate Commerce Commission in connection with the Block Signal and Train Control Board and also two state Commissions in connection with signaling matters.

You no doubt have some portions of your line which you feel should have attention from the signaling standpoint. Whether or not you have in your organization a man experienced in signaling I feel that I can be of assistance and value to you considerably in excess of my compensation.

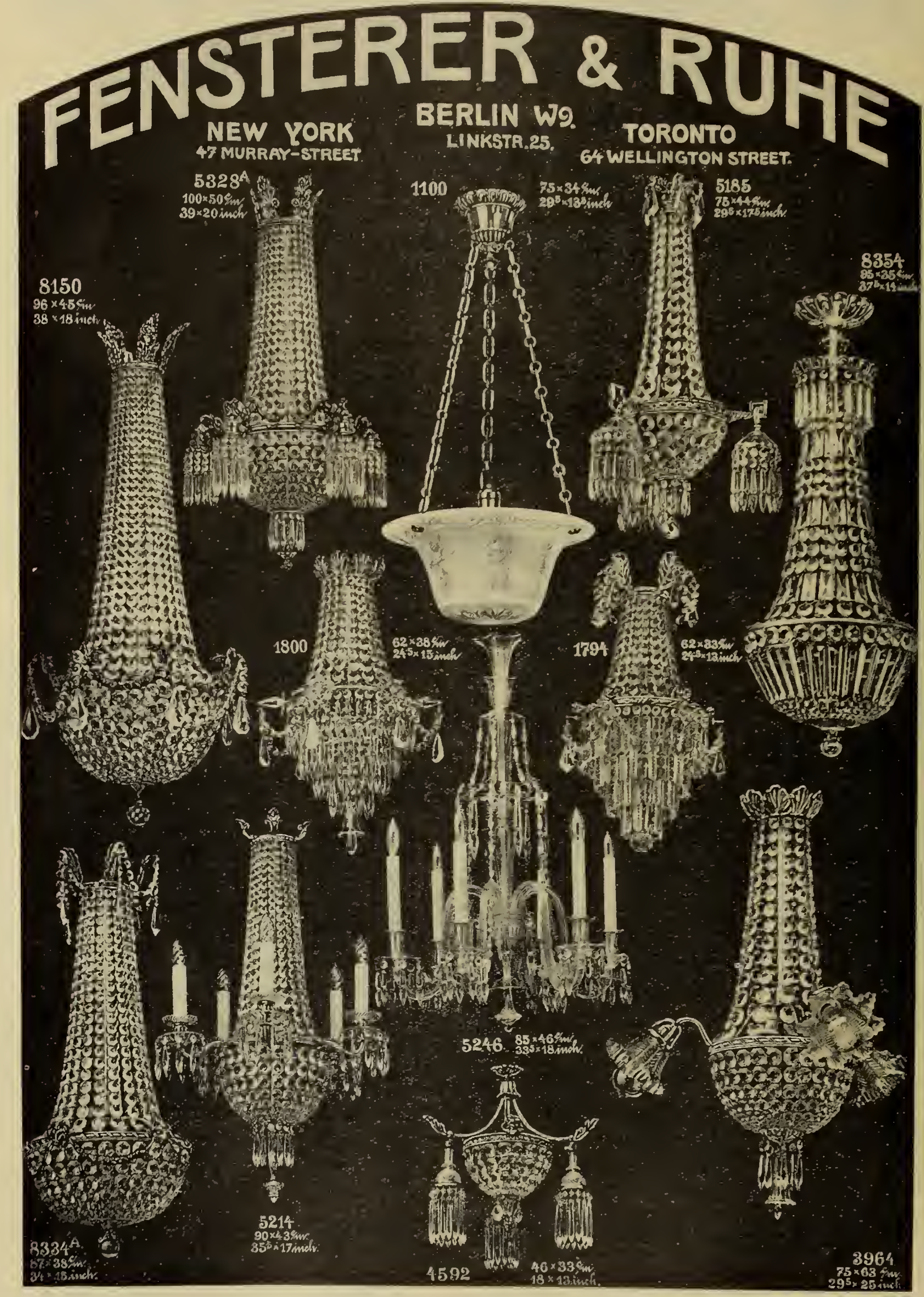
Why not drop me a line, regarding any problems which you have in hand and let me correspond with you about it with the idea that this correspondence may or may not lead to your retaining me.

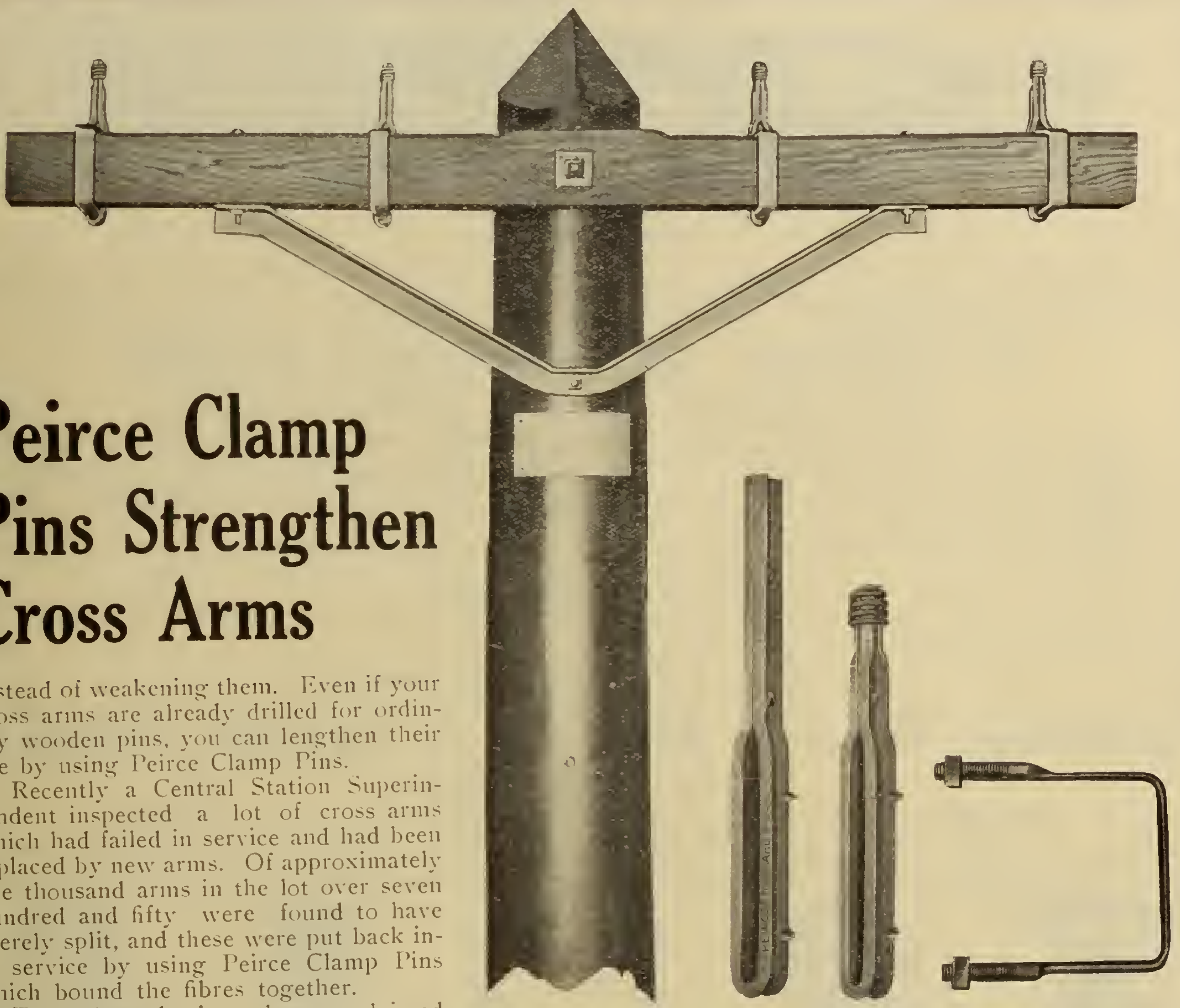
M. H. Hovey

Consulting Signal Engineer

446 Washington Building, **Madison, Wis.**

Investigations, Plans, Specifications, Estimates and Valuations


FENSTERER & RUHE
NEW YORK
47 MURRAY-STREET
BERLIN W9.
LINKSTR. 25.
TORONTO
64 WELLINGTON STREET.
5328^A
100×50 cm
39×20 inch
1100
75×34 cm
29^5×13^5 inch
5185
75×44 cm
29^5×17^5 inch
8354
95×35 cm
37^5×14 inch
8150
96×45 cm
38×18 inch
1800
62×38 cm
24^5×15 inch
1794
62×33 cm
24^5×13 inch
5246
85×46 cm
33^5×18 inch
5214
90×43 cm
35^5×17 inch
8334^A
87×38 cm
34×15 inch
4592
46×33 cm
18×13 inch
3964
75×63 cm
29^5×25 inch



Peirce Clamp Pins Strengthen Cross Arms

instead of weakening them. Even if your cross arms are already drilled for ordinary wooden pins, you can lengthen their life by using Peirce Clamp Pins.

Recently a Central Station Superintendent inspected a lot of cross arms which had failed in service and had been replaced by new arms. Of approximately one thousand arms in the lot over seven hundred and fifty were found to have merely split, and these were put back into service by using Peirce Clamp Pins which bound the fibres together.

Tests showed that these reclaimed arms when so equipped were stronger than new arms with wood pins.

The pins are rolled out of open hearth steel, properly designed for the exacting demands of modern service. The heavy coat of hot galvanizing gives full protection against rust.

Isn't it perfectly evident that, whereas a cross arm is seriously weakened by drilling holes for ordinary pins, it is bound to be stronger when clamped with steel bands such as those used in installing Peirce Clamp Pins?

Remember that a locust pin loses 40 per cent of its strength the first year, while the Peirce Clamp Pin lasts forever, and will carry an 800 lb. strain without deflection. All Peirce Clamp Pins are equipped with

The Peirce Spring Thread

which allows for expansion, contraction or inequality of bore, yet holds the insulator securely at all times.

In hot weather, it elongates and creeps further up in the insulator thread, preventing destructive pressure on the glass—in cold weather it still keeps closely in contact, and the insulator can't wobble.

Its resiliency is another advantage, helping to absorb sudden jerks or strains to which the wires might be subjected.

Peirce Specialties and Hubbard Line Hardware are carried by Canadian Electrical Jobbers.

The Hardware MAKES the Line, Hubbard Makes THE Hardware

Hubbard and Company, Pittsburgh, U.S.A.

"Look for the Gray Shell"

Light and Power Companies, Large Corporations, Industrial Plants, Mining and Smelting Companies, Department Stores, Hotels, Office Buildings, Electric and Steam Railroads, Steamships, U. S. Government, and many other classes of users are reducing fuse Maintenance expense over 80 per cent by using

ECONOMY RENEWABLE FUSES

They use Economy Renewable Fuses for these reasons:

First, of course, because it provides a practical method of reducing the fuse maintenance expense more than 80%.
Second, because it is the only renewable fuse that is uniformly rated.
Third, because it is the only design so far produced that provides the desired electrical characteristics.
Fourth, because all capacities of renewal elements are readily available, making large fuse stocks unnecessary.
Fifth, because they never vent fire or hold a sustained arc and are absolutely safe.
Sixth, because they meet the performance specifications governing the use of such devices.

Special Announcement!

Two Economy Renewal Elements are now furnished (without charge) with each Economy Fuse. Now YOU figure what fuse is the cheapest not only to buy but also to maintain.

Write for Bulletin, Prices and Discounts

Economy Fuse & Mfg. Co. of Canada, Limited

Herald Building, Montreal

ECONOMY Renewable Fuses are sanctioned by the Canadian Fire Underwriters' Association.

Good Material in the Hands of Good Workmen

plus experience and knowledge of service conditions result in quality device.

Outdoor Pole Top and Station Disconnecting Switches in all capacities and voltages, Bus Bar Supports, Cable End Bells, Switch Board and Pipe Frame Fittings, Inverted Suspension Supports for both pipe and flat mounting, Clamp Insulators, Station Pins and other Station and Transmission Specialties.

Suitable designs for any special conditions. You are assured of our responsibility by our Five Year Guarantee.

Send for our Blue Catalogue and Pole Top Switch Bulletin 100.

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10-12 N. Desplaines Street Chicago, Ill.

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Electrical News
Generation, Transmission and Application of Electricity

Published Semi-Monthly By
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HUGH C. MacLEAN, Winnipeg, President.
THOMAS S. YOUNG, General Manager.

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SUBSCRIBERS

The "Electrical News" will be mailed to subscribers in Canada and Great Britain, post free, for $2.00 per annum. United States and foreign, $2.50. Remit by currency, registered letter, or postal order payable to Hugh C. MacLean, Limited.

Subscribers are requested to promptly notify the publishers of failure or delay in delivery of paper.

Vol. 23 Toronto, February 1, 1914 No. 3

Knowledge of First Aid Methods

A recent letter by Mr. Chas. F. Gray, published in these pages regarding the large number of deaths from electric shock and the best means of precaution has been the means of arousing interest in certain quarters, but there seems to be a considerable apathy concerning this matter on the part, often, of those who are most vitally concerned.

Mr. Gray's suggestion of the formation of a committee composed of good first aid men is valuable; all the more that the very formation of such a committee would arouse general local interest in the subject. Of equal importance it seems to us, however, is it that a thorough knowledge of first aid methods should be a necessary and legally required qualification of every man who is engaged in any phase of practical electrical work.

Statistics apparently are not available as to the relative number of accidents, by electric shock, of electrical and non-electrical workers, but it is probably safe to say that (say) 90 per cent. of the total accidents happen where they might naturally be expected to happen, i.e., where some electric installation work or supervision is under way. As two or more men are almost invariably employed in this work it will be evident that a knowledge of first aid methods by the companions of the victim is an all-important consideration. We repeat again, therefore, that considering the simplicity of the different methods of resuscitation, the tremendous importance of immediate action and the likelihood of accident among electric workers it seems almost a case of criminal neglect that first aid knowledge has not been made a necessary legal qualification of every electrical workman.

Of the many methods of resuscitation it is doubtless a difficult matter to say which is the most efficient, and indeed the very nature of the subject renders it quite impossible that this should ever be determined. All the different methods are valuable and apparently efficient if promptly, properly and persistently carried on. The prime consideration is, without doubt, that some method or other should be used promptly. Of the manual methods it can perhaps be objected that, while very efficient, they depend too much upon the technical knowledge, good judgment and persistence of the attendants; of the automatic, that cost may be a consideration, that they need more or less regular inspection and that the more machinery the more danger of delays. Doubtless each municipality or company must consider all the different methods and adopt the one most suited to local conditions. On another page of this issue we publish a brief review of the more common methods of resuscitation now used and including an instrument recently introduced to the Canadian market which appears to have much to recommend it.

Canadian Electric Railways

In this issue we print a brief review of the electric railway situation in Canada. The past year has been one of average activity in spite of the adverse financial conditions, and although it is a little early to predict the amount of development that is likely to be carried through in 1914 there is good evidence that this will greatly exceed that of any previous year. Especially noticeable is the imminent development in interurban railway construction. The rural communities are clamouring for transportation as they have done for telephones and mail delivery and other urban advantages. There are many indications which point to a large amount of interurban construction during the coming summer.

Improvements in Turbine Design

As Canada is destined in the early future to be recognized as one of the greatest water-power countries in the world it is of considerable interest to note the decided progress made during the past two or three years in the efficiency of water turbines. A few years ago the average efficiency of a water turbine was in the neighborhood of 80 per cent. and guarantees by the manufacturer of anything higher than this were looked upon with distrust. The change which has taken place is shown by the fact that no guarantees less than about 87 per cent. are now offered, and in one specific instance at least, an efficiency up to 93.7 per cent. has been obtained.

The question of turbine efficiency and design is covered very fully in a paper recently presented by Mr. H. B. Taylor, before the mechanical section of the Can. Soc. of Civil Engineers, at Montreal, on January 15. Mr. Taylor states that the improvements are very largely traceable to the co-operation in recent years between hydraulic engineers associated with operating companies and the manufacturers of water turbines, this co-operation being all the more valuable on account of the practical experience of operating engineers—an experience which the manufacturer is necessarily unable to obtain. There is also a decided change in the attitude of the average purchaser of water turbines, who now appreciates the value of efficiency in his prime mover. Mr. Taylor calculates that the turbines in any hydro-electric installation only cost from 2½ per cent. to 10 per cent. of the total installation and when it is considered that the efficiency given at this point will be carried through every stage of the development it can easily be seen how necessary it is to exercise the greatest care in the choice of this fundamental. To quote Mr. Taylor on this point—"When it is considered that the success of the total development is absolutely dependent upon the power performance of the turbines, and the earning power on the total investment may be in proportion to the efficiency of the turbines the folly of chancing the installation of inferior apparatus is self-evident."

According to this article improvements have been shown in the general development of turbines as well as in all the auxiliaries of turbine casing, guide vanes, space between the guide vanes and runner, various sections of the draught tube, as well as in the design of gates, penstocks, etc. A noticeable change has come about in the introduction of the single runner unit as compared with the multi-runner type for low heads. Two striking examples of this are the recently completed installation of the Mississippi River Power Company with a head of 32 ft., and the installation of the Cedars Rapids Manufacturing and Power Company of Montreal, where a 30 ft. head plant is under construction. The generators in connection with both of these plants have a speed of about 56 r.p.m. and diameters of 32 and 36 ft. A noticeable improvement in general design is also shown in the absence of corrosion in the later types of turbine, which, it has been conclusively shown, was due to imperfect design. This chemical action was a troublesome factor in the earlier types of turbine before the cause was properly understood. It is stated that since improved design has eliminated the danger of corrosion it is now feasible to manufacture turbines of cast iron where recently it was considered necessary to use a special kind of bronze, the theory being that the iron was more susceptible to chemical action than the bronze. On other pages of this issue Mr. Taylor's paper is reproduced in full.

The Critical Public

At the recent annual meeting of the British Columbia Electric Railway Company considerable apprehension was shown by many of the shareholders at the small profits earned on capital by this company, which during the past year is only approximately 4½ per cent., including all the operations of the company, railway, light and power. It is very doubtful if the citizens of Vancouver and the surrounding neighborhood sufficiently appreciate the important part the B. C. E. R. has played in the tremendous developments that have taken place during the past few years in that district. While companies in many other cities on this continent have, by comparison, been starving their plant and hesitating to make extensions and expenditures the B. C. E. R. Co. have been almost lavish in their developments, apparently having at heart the interests of the section of British Columbia they serve rather than the particular and immediate interests of their shareholders. We know of no place on the American continent where this spirit has been more in evidence.

It is only human, of course, that there should be a certain amount of expressed dissatisfaction at the service given by the B. C. E. R. Co., but it simply goes to show that you cannot please all the people all the time no matter what sort of a service you give and no matter how much capital expenditure you may make for their comfort and convenience. The prominence of Vancouver, Victoria and the surrounding district to-day and the rapid increase in wealth of this section during the past few years is in a very great measure, indeed, traceable to the extensive development policy of this great company.

Special Trains to International Congress

Plans are already well under way for one or more special trains from the East to San Francisco in connection with the International Electrical Congress to be held in that city in September, 1915. The trains themselves will represent the last word in safety and comfort, while their itineraries will be laid out to include the finest scenery in the country.

The tentative programme, which at a later date will be submitted in detail to engineers of the United States and other countries for an expression of their individual preferences, includes a round trip of about 30 days' duration with stops in Chicago, Colorado Springs, Salt Lake City, San Francisco, Santa Barbara and Los Angeles. At each one of these places, special arrangements will be made by local committees for the comfort and entertainment of the members of the party. Other features of the trip will be the Royal Gorge, the Feather River Canyon, and a four-day visit to the Yellowstone National Park on the way out, with a 24-hour stop at the Grand Canyon on the way home. Should the demand justify it, a special train will also be provided from Chicago straight through to San Francisco to take care of those with whom time is a prime consideration. The transportation committee of the congress is further considering the possibilities of marine transportation by way of the Panama Canal. There appears to be a considerable demand for this, especially if satisfactory arrangements can be made for combining the land and water features.

Portable Wireless in Forestry Work

At a recent convention of the Western Forestry & Conservation Association held in Vancouver, B.C., Mr. J. R. Irwin, of one of the Marconi companies, gave an interesting address on the value of wireless equipment in the preservation of forests. Mr. Irwin explained that a portable wireless equipment not too heavy to be carried by one mule had been devised by his company and that this equipment had a range of from 15 to 25 miles. The following remarks referring to this equipment are interesting:—

"We are in a position to supply you with portable outfits which can be carried upon muleback and are built for strength and efficiency, and I shall first roughly describe which I consider the best unit for your work. It is estimated that the average mule pack is 90 pounds on each side of the saddle. We first adapt a saddle for our peculiar uses, utilizing it after it has been off-saddled as a stand or instrument table. Upon one side of the saddle we carry a small gasoline engine somewhat similar but lighter than a motorcycle engine. This is directly connected to a small alternating current generator which supplies us with the electrical power necessary to operate the wireless equipment. This piece of apparatus is the heavy part of the outfit and would occupy one side of the load. Upon the other side is a half kilowatt transformer, or as the case may be smaller, as the use for which it is required is considered. The half kilowatt transformer is the heaviest piece of the actual wireless set, and weighs approximately 25 pounds. On the same side of the saddle are located the condenser, helix, operating key and other small parts weighing but a pound or two. Here we also have the receiving outfit, which also weighs a trifle and could be carried in the pocket. On top of the saddle is the spool upon which is wound the antenna wire used for the aerial; this is of light flexible aluminum wire and is not weighty. A portion of it is also used as ground connections. Fuel is carried in tubes or tanks conveniently fitted on the saddle—also light bamboo rods fitted like a fishing-pole for a mast where high trees are not available. It is an idea of my own which I have not yet been able to prove if practicable, that gasoline could be carried in these mast tubes, thereby saving weight and space. This entire outfit can be off-saddled and quickly adjusted as it is practically set up upon the saddle.

The average distances over which you will require to communicate are from 15 to 25 miles. The set I have described would easily accomplish this and greater distances according to the conditions, which, of course, vary, but given the worst which we should figure upon, these distances would be a simple matter.

It has been pointed out to me that our system requires skilled operators. This is true to a certain extent but I would advise you that fully fifty per cent. of our operating staff is made up from men from the villages and small towns of the interior, men familiar with forests and country life, young fellows able to jump in and turn their hand to anything. These men are for the most part of good physique, a very large number being discharged from the army and navy after honorable service, with an excellent training and thoroughly subservient to discipline. I feel sure that men of this class could be adapted to your service."

Their Silver Anniversary

On December 27, 1913, the directors of the Canadian General Electric Company met to commemorate the twenty-fifth anniversary of the organization of a syndicate to inquire into the feasibility of establishing a system of incandescent lighting in Toronto, which syndicate subsequently organized the Canadian General Electric Company. At this meeting the history of the past twenty-five years was covered in a most thorough manner in an address given by Mr. Frederic Nicholls, the president and general manager of the company, in which he outlined the growth of the company's business as represented by an increase in assets at the rate of $1,000,000 a year for the full twenty-five years, by the amalgamation of some 16 companies of allied interests, and by the opening from time to time during that period of some 16 branches in addition to the large central head office in Toronto. The following extracts from Mr. Nicholls' address are of general interest to the electrical fraternity. They represent in a remarkable degree the possibilities of growth, past and future, in this Canada of ours, given only good management and confidence.

"On the 27th of December, 1888, I called together a number of gentlemen then, as now, prominent citizens of Toronto, with a reputation as successful and public spirited business men. They then affixed their signatures to a simple letter of agreement to join me in a syndicate to provide a fund to defray the expenses of inquiring into the feasibility of establishing in Toronto an electric plant to supply electric light and power by means of underground wires, and at that time I little thought of the tremendous development that lay before us.

The first company to be organized by the syndicate was the Toronto Incandescent Electric Light Company, on the 26th day of June, 1889, the intervening time since the organization of the syndicate having been occupied in negotiating an agreement with the Edison Electric Light Company, of New York, for the exclusive use of their system, and, by prolonged negotiations with the City of Toronto, for a franchise to generate electric light and power, and distribute the same by underground conductors. This company was very successful, and was subsequently amalgamated with the Toronto Electric Light Company.

Our next company was the Toronto Construction and Electrical Supply Company, which was incorporated on the 11th of February, 1891. This company was the parent company of the Canadian General Electric Company.

The business of the Toronto Construction and Electrical Supply Company was the sale of electrical apparatus and supplies, and soon after its incorporation, on the 14th of October, 1891, it formed an alliance with the Thomson-Houston Electric Company of Boston, and entered into an agreement to act as their sole agents for Canada. From the start this company was very successful, and secured in a short time such favorable recognition from the purchasing public that negotiations were entered into for the purchase of all the Canadian property and interests of the Edison Electric Light Company, including their factory at Peterborough, the Thomson-Houston and Edison interests in the United States having in the meantime been merged into the General Electric Company. After some delay in the negotiations, an agreement of purchase was concluded, and the Canadian General Electric Company was organized on the 5th of September, 1892, so that the Canadian General Electric Company, which was the outcome of the original investment of $10,000 by the syndicate of ten, has some time since attained its majority.

At the time we purchased the Canadian property of the General Electric Company, we also acquired the exclusive rights of the Edison Co., the Thomson-Houston Co., the Fort Wayne Electric Co., and the Brush Electric Co., and since then have from time to time acquired the Canadian business and good-will of many other companies that have enabled us to extend our field of operation, including amongst others: The Ball Electric Light Co., 1892; the Peterborough Carbon Co., 1895; the Electric Storage Battery Co., 1898; the Canada Foundry Co., 1900; the Royal Electric Co., 1900; the Stanley Electric Co., 1900; the Northey Steam Pump Co., 1902; the Sunbeam Electric Lamp Co., 1912; the Tungstolier Company, 1912; the Canadian Holophane Co., 1912; the Allis-Chalmers Mfg. Co., 1913; the Stratford Mill Building Co., 1913.

In May, 1901, the company purchased a valuable water power development, four miles from the Peterborough works, where our electric power for operating has since been generated, and in 1910 we secured a twenty-year leasehold from the town of Peterborough of a part of their waterworks dam, where we have developed an additional 1,000 horse power.

I do not desire to pose as a prophet, for the reason that our own future must run parallel to the future development of our country. Personally, I have the utmost faith in the future development and continued prosperity of Canada. Occasional set-backs we must expect, but the march of progress must be always onward, as so much of our great country still remains to be developed and populated. Next year, two new transcontinental railways, the Canadian Northern and the Grand Trunk Pacific, will be in operation for the first time, operating through trains from the Atlantic to the Pacific. The Canadian Pacific Railway have increased their trackage, rolling stock, and other facilities, at an expenditure equal to that required to build a new railway from ocean to ocean. The contracts for the new Welland Ship Canal have been let by the Dominion Government. Public works of great magnitude are either under construction or being projected by the Federal and Provincial Governments. Up to the present our immigration has continued to increase, so that, taking it all in all, the future is full of promise even though for some short while we may experience a recession in trade, as a result of the present world-wide financial uncertainty.

Mr. F. A. Vanderlip, President of the National City Bank of New York, an authority on financial and trade statistics, in a recent address, made the statement that the intelligent development of the electrical industry in the Uniter States will readily absorb for the next five years, $400,000,000 a year, or $8,000,000 a week. I do not predict that in Canada our percentage of trade, on a pro rata population basis, will be so startling, but there is no reason why we should not expect a satisfactory growth in the demand for our products.

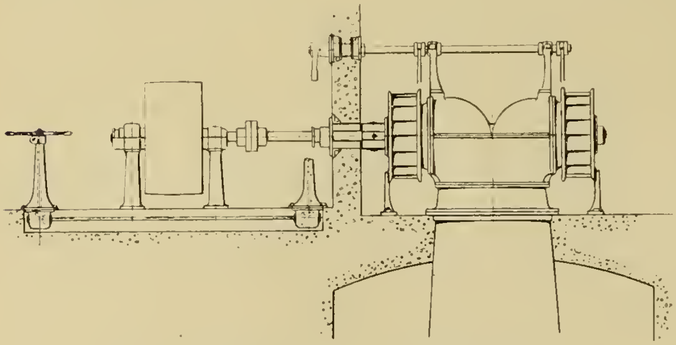
A normal growth of population may be counted on. The trunk line railways will undoubtedly electrify certain sections, such as terminals and mountainous divisions, and I am pleased to say that the first two important contracts that have been let for the electrification of steam railways in Canada have been awarded to this company. I refer to the electrification of the Rossland-Castlegar division of the Canadian Pacific Railway in the Rocky Mountains, and the electrification of the tunnel under Mount Royal, and the Montreal Terminal, for the Canadian Northern Railway.

In considering the future uses of electricity in Canada, we must have in mind the impetus this industry has received as a result of the utilization of our magnificent water powers. Few realize that from Quebec in the east, to Victoria, B. C., in the west, nearly every city, town and village has the advantage of hydro-electric power for its lighting, its street railways, and its industries. Quebec, Montreal, Ottawa, Toronto, London, Port Arthur, Fort William, Winnipeg, Calgary, Vancouver, Victoria, and intermediate points, are all operating hydro-electrically, and our reserves of water powers undeveloped will serve the needs of the country beyond our time."

The eight men who first conceived the idea of the formation of the syndicate which was the nucleus of the present great Canadian General Electric Company were Messrs. Frederic Nicholls, W. R. Brock, W. D. Matthews, J. K. Kerr, Geo. A. Cox, Robt. Jaffray, Hugh Ryan, and H. P. Dwight, and Mr. Nicholls referred with some feeling to the unique record of six out of the eight original directors who are still acting in that capacity after an unbroken period of a quarter of a century.

Chapleau Electric Light & Power Company

The Chapleau Electric Light & Power Company, have just increased their capacity from 200 h.p. to 400 h.p. to meet the growing demands of their vicinity for electric power. The draft tube and draft chest of the old turbines were not disturbed, but simply new "Francis" runners and "Fink" gatecases of specially powerful design were attached and give the desired increase in power. The shafting, coupling, gate regulating mechanism, collar oiling thrust bearing, lignumvitae bearings and generator drive are all new, very heavy and up-to-date. The diagram herewith indicates the layout of the hydraulic end of the Chapleau plant; the generator is belt driven.



Plan of hydraulic end of Chapleau plant.

The new turbines and machinery were built and installed by The Wm. Kennedy & Sons, Limited, of Owen Sound, Ont. The generator was supplied by the Canadian General Electric Company. The consulting engineer, for the power company, was Mr. J. B. McRae of Ottawa.

A Correction

In the article on page 60 of the January 15th issue of the Electrical News describing the 1000 kv.a. oil-cooled transformers recently installed by the Winnipeg Electric Railway Company, the high tension voltage was erroneously given as 5,500. The correct voltage is 55,000.

"If the paper had nothing but its advertisements, I would buy it just to read them."

McGill Science Men Hold Reunion

On the evening of Saturday, January 17, the Ontario graduates of the Faculty of Applied Science of McGill University, Montreal, held a reunion at the Engineers' Club of Toronto. The meeting was a particularly happy and successful function and was attended by over fifty. The guests of the evening were: Dr. Adams, Dean of the Faculty of Applied Science of McGill University; Dr. Galbraith, Dean of the same faculty at the University of Toronto, and Professors C. H. McLeod and N. N. Evans, of McGill University.

After a pleasing menu had been disposed of and the toast to the King had been duly honored, the chairman, Mr. Willis Chipman, in a happy speech welcomed the graduates and introduced the toast-master, Professor Evans, who discharged the duties of this office most capably. The toast list was as follows:

"Our Alma Mater," proposed by Mr. W. F. Ferrier, B.Sc., and responded to by Dr. F. D. Adams.

"Applied Science," proposed by Mr. J. G. G. Kerry, M.Sc., and responded to by Professor C. H. McLeod.

"Sister Universities," proposed by Major T. Harry Jones, and responded to by Dr. Galbraith.

In proposing "Our Alma Mater," Mr. Ferrier, in an enthusiastic speech, directed the attention of those present to the prominent positions held by graduates of McGill University and showed how their achievements had brought honor to their alma mater. Replying, Dr. Adams reviewed the history of the Engineering Faculty from the time of its formation, showing how it had grown from a small class back in the 60's to a world-renowned institution with the present large attendance of 580. In the early days there were few buildings and less facilities, but now the advantages offered by the Faculty placed McGill in the forefront of engineering schools. Curves had been prepared showing the attendance from 1880 and the rapid increase as shown graphically was very marked. An idea of the cosmopolitan nature of the student body might be gathered from the fact that forty different nations were represented at McGill. The graduates were distributed over the greater part of the inhabited sections of the world and everywhere the name of the University was being upheld by men who were forging ahead in their profession.

An important announcement made by Dr. Adams was that Sir Wm. MacDonald had donated a site of some twenty-seven acres for the erection of new buildings for the University, these to comprise residences, gymnasium and edifices for the various faculties.

Mr. J. G. G. Kerry, in proposing "Applied Science," dealt with the men who were graduates of this faculty, making interesting reference to the achievements of those who stood out most prominently. Professor McLeod's response was along much the same lines as Mr. Kerry's observations and was particularly well received, practically all of those present having sat under Professor McLeod at college.

In proposing the toast, "Sister Universities," Major Jones commented upon the good spirit which existed between the several colleges and expressed gratification in knowing that instead of a feeling of jealousy there was one of friendly rivalry—a feeling which tended to give the students a most efficient and successful training. Dr. Galbraith, who replied, spoke at some length on the proper education of the engineer. A great many people entertained the idea that an engineer should be a master of mathematics and the sciences—a theoretical expert, but this was an erroneous principle. The student should be grounded in the first principles of the sciences and shown how to apply them. In this way the future engineer would be able to grasp what was required for the solution of any particular problem and would know where to seek and how to apply the necessary knowledge and theory. The main theme of Dr. Galbraith's address was a common-sense, practical education for the engineer.

The toast list completed, Mr. Chipman called upon the assembly to honor the oldest engineering graduate present, Mr. Maurice Gaviller, who responded, giving some interesting reminisences of his experiences at McGill University in 1861-3. Mr. J. McEvoy then proposed the health of the toastmaster, Professor Evans, who replied with characteristic heartiness. Professor Evans' remarks were of particular interest in that they touched upon the work accomplished in connection with the Graduates' Society, an organization designed to keep track of the graduates and maintain a man's university connection by means of bulletins. It may be noted that the onus of the heavy duties involved in this work is borne by Professor Evans, who is honorary secretary. After the thanks of those present had been tendered to the committee in charge of arrangements by Mr. A. R. Davis, and acknowledged by Mr. J. R. Larmonth, a very pleasant evening came to an end. Mr. Willis Chipman came in for considerable congratulation as the proposer of the reunion and as one who had been particularly active in bringing the idea to a successful consummation.

The personnel of the committee was as follows: Mr. Willis Chipman, chairman; Messrs. W. F. Ferrier, J. McEvoy, A. L. Mudge, J. H. Larmonth, E. R. Clarke, H. G. Nicholls and M. J. McHenry (secretary).

Resuscitation From Apparent Death by Electric Shock

When attempting resuscitation from apparent death by electric shock the experience of every person who has been engaged in this particular work points to the necessity of the immediate application of some process or other. The first few moments are of the most vital importance.

The methods that may be adopted are in general very similar to those which are recommended for drowning. It is very important that the lungs should be cleared as completely as possible of all obstructions; also the passage leading to the lungs. The tongue should be well drawn out, sharply, so as to clear a path to the lungs.

Of the methods that have been advocated these may be said to divide themselves roughly into two classes—the manual or mechanic and the automatic. Of the former or mechanical process the two which have received most prominence are the Sylvester Howard and the Schafer methods. Both of these are excellent if immediately applied, though they depend, of course, upon the human element and require a certain skill, that is only attained by frequent practice in these methods.

The Sylvester Howard method consists of laying the patient on his back, and proceeding with the well-known resuscitation methods as applied in cases of drowning. The arms are extended above the head, and then returned to the side of the body in a bent position,—that is to say, with the elbows touching the floor—whilst the hands are brought back as near the shoulders as is possible. At the same time, when the arms are being brought back from the extended position to the side of the body, pressure is applied to the chest. This allows a very definite intake and exhaust of the lungs, the muscular effort, etc., all assisting towards resuscitation. The method, however, necessitates two men fairly well skilled in the operation.

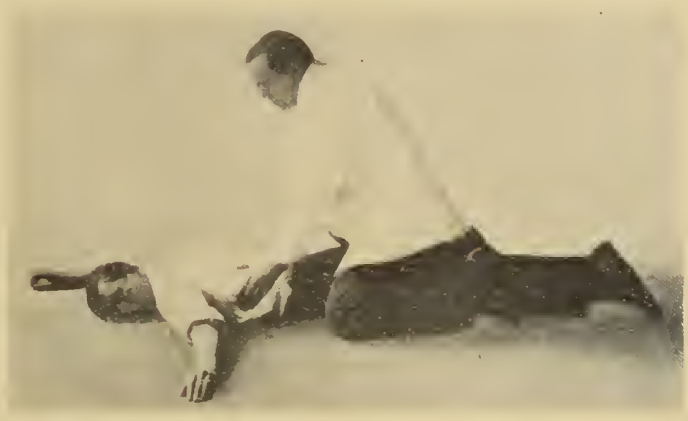
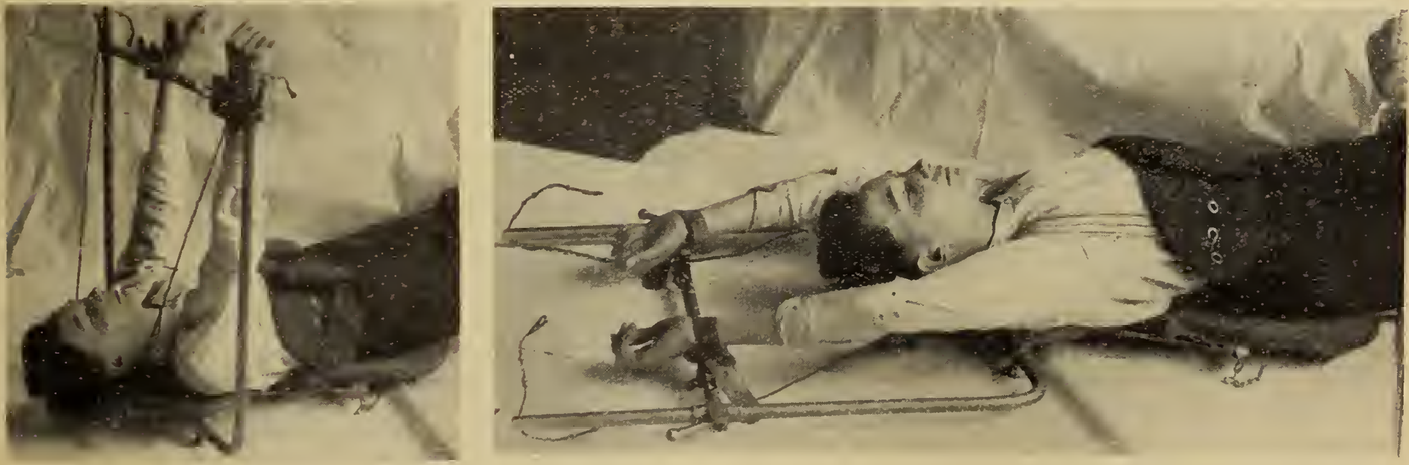


Fig. 1—Schafer method of resuscitation.

The Schafer method is somewhat simpler though possibly as effective. The patient in this case is laid upon his stomach and pressure applied to the small of the back as shown in Fig. 1. The attendant then swings forward and backward slowly depressing and releasing in unison approximately with his own breathing. This can be carried out by one person though the operation is tiresome, and there is danger that the work will be discontinued too soon.

In both the above methods, the human element enters into the success of the operation very considerably, and the movements should not be carried out in a hasty manner, particularly in the Howard process, in which one man must follow the other quite closely. The rate of the movements should be approximately the same as the time of one's own breathing. It is also necessary in this method as in all others, to see that the tongue is clear of the throat, and also that all the passages of the throat are free from any matter, blood, etc. Any scheme can be adopted to lift the tongue out, as with a handkerchief, and tying the same when using the



Figs. 2 and 3—Showing simple automatic equipment adapted to mechanical methods of resuscitation.

Howard process, but in the Schafer process the tongue will naturally fall forward.

Of the automatic equipments for resuscitation an instrument called the Pulmotor is probably the best known in Canada. This is a simple apparatus designed for performing automatic artificial respiration. When applied to the person to be resuscitated the lungs are first filled with air until normal pressure (eight inches water pressure) is reached when deflation immediately commences. These operations are continued automatically as long as required. A natural respiration is thus imitated as nearly as possible and is maintained regularly throughout. The pulmotor is, further, supplied with an oxygen reservoir and a certain amount of oxygen is mixed with the air as it is introduced into the lungs. It will be seen that this instrument when once at work, properly installed, should be very efficient. Its machinery, however, is somewhat complicated and delicate. It has also the objection which must hold for all automatic equipment that it takes a certain length of time to get it on the spot and to apply it. As an auxiliary to one or other of the mechanical methods there can be no question as to its great usefulness.

A simpler and apparently equally effective apparatus has very recently been placed on the Canadian market by Chapman & Walker, Limited, called the "synchron." The method adopted in this case is perhaps best described as an automatic mechanical method in that the apparatus can be readily adapted to either the Howard or the Schafer processes as described above. The patient is placed in the apparatus, his arms being carried upon a frame which is rocked, and this rocking motion not only moves the arms from a position extended above the head to a position extended in front but also compresses the abdomen at the right moment thus producing a very definite intake and exhaust of the lungs. The illustrations given in Figs. 2 and 3 show the simplicity of the apparatus and its easy operation. The machine is easily adjustable to any size of person.

The "synchron" has a rigid construction and there seems to be little possibility of its getting out of order. It consists chiefly of an oak base arranged for supporting the shoulders and head. Around the body an iron girth band is placed for compressing the abdomen or the back according to the particular process of manual resuscitation being adopted. The arms are carried in a frame moving through 90 deg. All the operator has to do is regulate the frame in unison with his own breathing and a perfectly synchronous cooperation between the movement of the arms and the movement of the chest is obtained with practically no fatigue to the operator, who is thus enabled to continue the operation for hours if necessary. It is on account of this absolute synchronism in the movements obtained that the instrument has been named the synchron.

It will be seen that this instrument endeavors to combine the advantages of the mechanical and automatic methods. It is cheap and can be made that much more easily available. It is quickly installed on account of its simplicity. For the same reason it is not likely to get out of repair during its use or to be out of repair when required suddenly. One operator is sufficient to manage it and the operation is not sufficiently vigorous to tire him to such an extent that he would be inclined to discontinue the work of resuscitation.

Developments in Hydraulic Turbines

Present Practice In Design and Construction—Marked Advance In Efficiency —A Matter of Prime Importance In Canada

By Mr. H. Birchard Taylor,* M. Am. Soc. M. E.

During the past ten years, hydraulic turbine design has passed through a stage of wonderful development and, in respect to many features, remarkable progress has been made toward bringing the turbine to a high state of perfection:

1st. As a result of theoretical investigation, substantiated by experimental research of the highest order, efficiencies have been increased on the average about ten per cent.

2nd. Corrosion of runner vanes, at one time a serious factor as affecting the maintenance of turbines and their efficiencies, has been eliminated subsequent to conclusive demonstration that it is primarily the result of defective design.

3rd. The development of high specific speed runners, thereby permitting the use of higher rotational speeds, has resulted in the rapid passing away during the past few years of the multi-runner types of turbines in favor of the vertical shaft, single runner type.

4th. At one time it was generally thought that the character of speed regulation of a turbine was dependent entirely upon the governor. Today, however, it is known that the make or type of governor has little or nothing to do with speed regulation, except in so far as it must have sufficient power and proper mechanical adjustments to move the turbine gates in a certain time and without hunting.

Efficiency

Ten years ago it was considered a notable achievement to obtain in a turbine in place an efficiency as high as 82 per cent. The average of the best results secured was in the neighborhood of 80 per cent. The maximum guarantees of the builders were from 78 to 80 per cent. and were considered highly satisfactory.

During the past two years, efficiencies between 89 and 92 per cent. have been quite common, while a maximum value of 93.7 per cent. has been secured. Today the builder must guarantee an efficiency of at least 87 per cent. in order to secure business.

This remarkable increase in efficiency is by no means entirely due to superior runner design. As a matter of fact, the improvements in the design of wheel-casings, wicket gates, draft chests and draft tubes have increased the efficiency of the turbine as much as the more efficient runners.

It is interesting to note that the improvement in turbine efficiency has taken place during the time when the general policy of the power companies toward the builders has changed from one under which a great majority of contracts were awarded to the lowest bidder to the present one under which merit is frequently given first consideration.

Under the former policy, business was secured by the builders at such prices as to allow little or no margin between actual cost and selling price. As a majority of turbine installations undertaken ten years ago were unsuccessful at the start, and required alterations or replacements to make them acceptable, the contracts which showed a profit were few and far between. Thus there were frequently no funds available to cover the cost of experimental work by the builder to improve the quality of his product. As the data available ten years ago was by no means reliable, a majority of the builders had very little assurance of the successful outcome of their work. There was, consequently, a very strong incentive on the part of some of the builders to avoid, if possible, the making of any tests which might prove that the apparatus had failed to meet the guarantees.

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* Hydraulic Engineer, I. P. Morris Co.

Most of the important contracts are now awarded on a basis of merit, and designs and guarantees are given far more consideration than price. A great amount of work is done on a cost and percentage basis, whereby the builder is guaranteed a profit contingent, of course, on the proper execution of his part of the agreement. The ability of the builder properly to construct the apparatus in accordance with his designs is now taken into consideration in comparing competitive designs.

A high guarantee of efficiency is no longer satisfactory to the purchaser unless it can be justified by conclusive evidence in the form of reliable data secured from tests on similar apparatus, or in connection with experimental turbines tested by disinterested parties. The builder who, by the presentation of such data, demonstrates that his guarantees will probably be exceeded, is given preference over his competitor who, although he may have made the same guarantee, is unable to prove that he has an equal margin in reserve.

Engineers of power companies are now taking a much greater interest in the experimental work of the builders than previously, frequently volunteering to share in the expense; provided, of course, that such work will be of some aid to them in selecting the best type of apparatus. In some instances, power companies have allowed under contracts certain sums of money to be expended on experimental work to be carried out by the builder.

In many contracts for waterwheels placed during the last few years the builders have been required to guarantee the efficiency on a bonus and penalty basis, the rate ranging anywhere from $1,000 to $5,000 per unit for each one per cent. of efficiency, the rate in each particular case depending, of course, upon the value of efficiency to the purchaser.

More Co-operation

This co-operation on the part of the power companies has been a very important factor in producing the remarkable improvement in efficiency which has been obtained during the past ten years, for it has made possible the expenditure by the builders of very considerable sums of money to cover the costs of research and experimentation. There is probably no doubt in the mind of anyone that the power companies have benefitted many times more than the builders as a result of this experimentation made possible by their liberality.

Another important factor in the rapid strides made in waterwheel design during the past ten years has been the co-operation on the part of the consulting hydraulic engineers who, necessarily, have had a very extended and valuable experience in the design and operation of hydraulic machinery; and in the efforts of builders to solve various problems which present themselves, the advice of these engineers has been eagerly sought and cheerfully given.

The present attitude of the power companies toward the builders has undoubtedly been the result of a better appreciation of the fact that the success or failure of any hydro-electric development depends primarily upon the performance of the turbines. The total investment of a hydro-electric development is represented in the water rights and franchises, the dam and power house, the turbines, generators, electrical transformers, the transmission lines and other equipment. This investment may involve many millions of dollars. The amount paid for the turbines themselves is only a small proportion of the total investment—say from 2½ to 10 per cent. When it is considered that the success of the total development is absolutely dependent upon the proper performance of the turbines, and that the earning power of the total investment may be in proportion to the efficiency of the turbines, the folly of chancing the installation of inferior apparatus is self-evident.

In comparing designs prepared ten years ago with recent designs, the most striking feature is the absence in the latter of sudden turns and abrupt changes of section in all water passages from the turbine casing to the tailrace; and, although in the older designs these passages were thought to be consistent with good results, they now appear to be exceedingly crude. The elimination of losses due to eddies and whirls, abrupt changes of section and sudden curvature in the various parts which constitute the turbine has improved the efficiency of the turbine as a whole.

By means of the Pitot tube, it has been possible accurately to determine the conditions of flow in the various parts of the turbine casing, through the guide vanes, in the space between the guide vanes and the runner, and also in various sections of the draft tube. Thus it has been possible to compare actual conditions of flow in these various parts with the calculations.

Extensive Tests

The waterwheel builders in the past five years have carried on very extensive tests at the Holyoke testing flume in Massachusetts on small runners ranging, in most cases, from 12-in. to 36-in. in diameter. These runners are exact models of the large runners which the builders contemplated installing in the turbines. Various designs of wicket gates and draft tubes are used in connection with the testing of these models. The results of these tests have given the builders very valuable data upon which to base the design of any new work calling for runners of like characteristics. The builders have also been able to secure from these tests empirical constants by which they have been enabled to modify their theoretical data.

The head corresponding to the velocity of discharge from the runner into the draft chest or tube may represent a considerable proportion of the total head acting on the turbine. This is especially true in the case of runners of high specific speed, where this velocity head may be as great as from 25 to 30 per cent. of the total head acting on the turbine. It is, therefore, essential to design the draft tube most carefully, in order to convert this velocity into effective head.

Improvements in the design of draft tubes has been very marked indeed and has resulted in a considerable increase in the efficiency of turbines. It has only been within recent years that hydraulic conditions within the draft tube have been fully appreciated. It was at one time thought that the draft tube was simply a device by means of which it was possible to locate the turbine above tailwater level without losing the effective head represented by the difference in elevation between the turbine and the tailrace. Today, however, the draft tube is looked upon as an extremely important part of the turbine; in fact, it may be said that without efficient draft tubes runners of high specific speeds would be impracticable.

There have been built in times past quite a number of draft tubes with constant diameter from the runner to the tailrace. Consequently, the velocity which existed in the section immediately at the discharge from the runner existed also at the end of the draft tube, and the energy represented by this velocity was entirely lost to the turbine, in addition to the frictional loss resulting from the condition of high velocity throughout the entire length of the draft tube. The efficiency of turbines with draft tubes so designed is necessarily extremely low. By properly designing the draft tube from the section immediately at the discharge from the runner to the tailrace so that the velocity is gradually reduced from a maximum at the runner to a minimum at the tailrace, the vacuum in the draft tube may be increased and, consequently, the effective head on the turbine.

Until the last two years a large majority of the turbines installed in connection with low and medium heads were of the old fashioned multi-runner type, consisting of two, four, six and sometimes more runners on a shaft, these runners being grouped in pairs, each pair discharging into a common draft chest and tube. The energy represented by the velocity at the discharge from the runners was practically lost to these turbines, owing to the losses due to impact and eddies and whirls existing in the draft chests and tubes as a result of the runners discharging against each other. Consequently, there was practically no reconversion of the velocity head from the runners into useful head.

Ten years ago the draft chest and draft tube designs of turbines of these types were exceedingly crude. Improvements have been made, of course, from time to time until the multi-runner unit, when now built, is quite an efficient machine. The principal improvements have been in allowing a greater distance between the runners which discharge into a common draft chest, and in designing the draft chest so that the water from each runner is carried into the draft tube to a point where the two streams are moving in parallel directions, before allowing them to converge; but even with the best design of turbines of the multi-runner type, there is always present an appreciable loss due to the comparatively sudden turns which the discharge water from the runners must necessarily follow.

With runners of medium specific speed in a multi-runner setting, it is sometimes possible to obtain efficiencies approaching those developed by the experimental runner, provided, of course, that the draft chests and draft tubes have been carefully designed. In other words, the losses in the draft chest and draft tube about equal the losses which exist at the Holyoke testing flume, where the runner is small, and where the intake and draft tube losses are necessarily appreciable on account of the construction of the flume. On the other hand, should runners of extremely high specific speed be adopted, in which the discharge velocity from the runners represents a very considerable portion of the total head acting on the turbine, it is found that the efficiency seldom reaches that of the experimental model. It may be mentioned that the experimental model is usually operated in a vertical setting, with a single draft tube, and consequently the losses which exist in the draft chest of the multi-runner setting are not present in the experimental setting.

General Design Often Faulty

In many of the power developments carried out a number of years ago, and in some few instances in more modern plants, even such efficiency as could be obtained from the turbines cannot be realized in the operation of the plant as a whole. Poor designs of the waterways leading to the turbine casing and receiving the discharge from the draft tube cause considerable losses outside of the turbine passages. In some instances, much attention has been given to slight variations in turbine efficiency, while losses of head amounting sometimes to one or two feet, occurring through submerged arches, bridge piers or racks, have been overlooked.

Many recent developments are being much more carefully worked out, so that there are gradual transitions in water velocity at entrance to the turbine casing and at discharge from the draft tube into the tailrace; and practically the entire efficiency of the turbine is realized in the operation of the complete plant.

Accompanying a growing appreciation of the value of efficiency, engineers are giving increased attention to the mechanical features of turbine designs and to questions of deterioration of the machinery during operation. It is now realized, especially by those who have been taught by the school of bitter experience, that mechanical reliability and stability of construction are of even more importance than efficiency, since continuity of operation and freedom from interruption for repairs are vital considerations. Among other sources of interruption to service, the deterioration of runner vanes has in the past been a frequent cause of trouble.

Corrosion of Runner Vanes

Corrosion, or pitting of runner vanes, guide vanes and draft tubes, is no longer a serious obstacle to be contended with in the operation of hydraulic turbines as its cause is now pretty well understood and, by correct designing, can be eliminated. Turbine builders do not hesitate to design and construct turbines for operation under any head up to 650 feet and to guarantee their lasting qualities, provided the speed and power in each case are so chosen as to be consistent with favorable hydraulic conditions.

Corrosion, or pitting, must be distinguished from erosion, which is mechanical wear due to the presence of foreign substances in the water. Erosion is entirely a mechanical action, while corrosion, or pitting, is the result of chemical action. The abrasive action of foreign substances in the water has the effect of first polishing the vane surfaces, and eventually cutting away the metal until the vanes are worn entirely through. The eroded parts are, therefore, smooth and can be readily distinguished from the pitted marks which result from corrosion.

The elimination of corrosion as a serious factor in turbine design is the result of a careful study of the subject, after many years of costly experience on the part of both the power companies and the turbine builders. It has been demonstrated that corrosion is primarily a question of design. It has been clearly shown in practice that where sharp curves are resorted to, where contraction is not sufficient, or where there are pockets formed in the surface of the vanes, pitting or corrosion inevitably develops. It has also been demonstrated that where air in large quantities is entrained in the water carried to the turbine, corrosion seems to take place very rapidly if the design is not correct.

While it is true that corrosion takes place more quickly under high heads than under low heads, runners operating under heads as low as 25 to 30 feet have been found in some cases to corrode very rapidly. It is, therefore, essential that the runner be carefully designed, regardless of the head under which it is to operate, but extreme precaution must be taken in cases where the head is excessively high.

A corroded vane surface has an appearance resembling a sponge, the surface being extremely irregular and the pitted spots often opening holes entirely through the vane. Chemical analysis of the corroded surfaces has brought out the fact that the metal has been oxidized. In runners made of bronze or an alloy, modifications in the composition have been detected in the corroded portions.

The theory of corrosion as now generally accepted is that the water in passing over any pocket or depressed surface, or in failing to adhere to the surface of the vane, leaves spaces which are filled with eddies possessing high velocities and very low static pressure, in which oxygen is liberated from the water. This oxygen is believed to be in the nascent state and rapidly attacks the surface of the metal, forming an oxide coating, the greater part of which is rapidly washed away by the water. When once the depth of this pocket is increased by corrosion, it is natural that, due to the greater area exposed, the pitting action should continue at an accelerated rate until the vane is entirely eaten through.

It is quite likely that electrolysis is present as a result of the oxidation of the metal, for it has been noticed in connection with runners of the built-up type—viz., runners in which plate steel vanes have been used with iron or bronze bands and hubs—that corrosion seems to develop more rapidly than in the case of runners made of uniform metal. Foreign engineers have called attention to the fact that in some instances they have observed that the metal eaten out by corrosion at one section of the runner has apparently been re-deposited at another section, a condition evidently resulting from electrolysis. If electrolysis does exist, it is a secondary action and may be eliminated by first preventing corrosion.

The fact that a runner develops high efficiency under test is not, necessarily, a guarantee that corrosion will not take place. Small defects in the curved surfaces of the runner vanes will be very quickly brought out by the fact that they corrode; while on the other hand these defects in the flow through the runner may be too small to be detected in an efficiency test. In general, however, it may be said that high efficiency and freedom from corrosion are complementary qualities.

While corrosion is primarily caused by defective design, some metals are more susceptible to its action than others. For example, bronze resists corrosion better than does either cast steel or cast iron; but if the runner is so designed as to permit corrosion to take place, it matters little what metal is used. Runners regulated by means of cylinder gates are particularly subject to corrosion, owing to the eddies produced behind the cylinder gates at fractional gate openings.

Corrosion will often develop in a runner if the turbine is operated continuously at low gate openings. The falling-off of the efficiency of a turbine at low gates is an indication that the hydraulic conditions within the runner are greatly disturbed, and this disturbance tends to promote corrosion. High specific speed runners, if applied to high heads, are also subject to corrosion, owing to the high velocities to be dealt with and the difficulty in making the water follow the radical curves characteristic of the vanes of these runners.

Cast Iron Now Used

Cast iron to-day is used as a material for runners to a much greater extent than heretofore and, as a result of careful designing, it has been successfully employed under conditions which, until recently, were thought to be impossible. As an example, in the case of the four 18,000 horse-power turbines operating under a head of 420 feet in the plant of the Great Western Power Company, it might be mentioned that two of the units were equipped with runners of special bronze, the third with a runner of cast steel, and the fourth with a runner of cast iron. These turbines have been in operation since 1908 and a recent inspection has shown all of the runners to be in equally good condition, there being no evidence of serious corrosion in any of them.

Cast steel is thought to be the most undesirable metal from considerations of corrosion, on account of the unavoidable roughness of the surface. In the casting of steel runners it is very difficult to make the metal flow into the thin vane sections without chilling, unless extremely high temperatures are employed. These temperatures often result in the production of uneven surfaces, on account of the difficulty of obtaining sufficiently refractory material for the surfaces of the mold.

Corrosion has often been greatly accelerated because of poor draft tube conditions. It has been only recently appreciated that the total draft head acting on the turbine, or the negative pressure on the discharge side of the runner in feet of water, is equivalent to the vertical distance from the tailwater elevation to the runner, plus the head corresponding to the velocity of the water as it passes through the discharge section of the runner, minus the losses in the draft tube, minus the head corresponding to the discharge section of the draft tube. In modern plants, the last two factors entering into the total draft head have been kept within negligible values.

It is evident that should the total draft head, or the sum of the static draft head and the velocity head at the runner discharge, exceed the height of the water barometer, the continuity of flow of the water on leaving the runner is destroyed. When the absolute static pressure in the draft tube falls to a value equal to the vapor tension corresponding to the temperature of the water, the water will vaporize and the draft tube will not be filled with a solid column of water from the tailrace to the runner. Therefore, the placing of a turbine simply within 34 feet from the elevation of tailwater is no indication that the elevation has been properly chosen; for aside from the limitations outlined above, it is also necessary to allow at least three or four feet margin between the total draft head and a perfect vacuum to prevent the breaking of the column of water in the draft tube due to inertia effects resulting from sudden changes of load on the turbine.

It must also be borne in mind, and this is a point which has been frequently overlooked, that in figuring the margin between the maximum vacuum and the total draft head, the maximum vacuum should be considered for the particular elevation above sea level at which the turbine is to be installed. The fact that the question of draft head has not been clearly understood has resulted in the location of a great number of turbines at such heights above tailwater that the benefit which would otherwise be secured by means of the draft tube has been largely sacrificed. In a number of cases where the draft head has been excessive, corrosion of the runner vanes has developed at a rapid rate, and this corrosion has also attacked the runner band and draft tube in the neighborhood of the runner.

If, therefore, the runner vanes are so designed as to give sufficient contraction to the stream to prevent the water leaving the vane surfaces, if the speed selected is consistent with good hydraulic conditions, and if the elevation of the turbine above tailwater level is properly selected, there is no reason for anxiety over the possibility of corrosion developing to any appreciable extent. In respect to erosion, however, although the best metals are used in resisting its action and high factors of safety are adopted in all parts of the machinery which may be subjected to it, erosion must necessarily be expected wherever the quality of the water is such as to produce it.

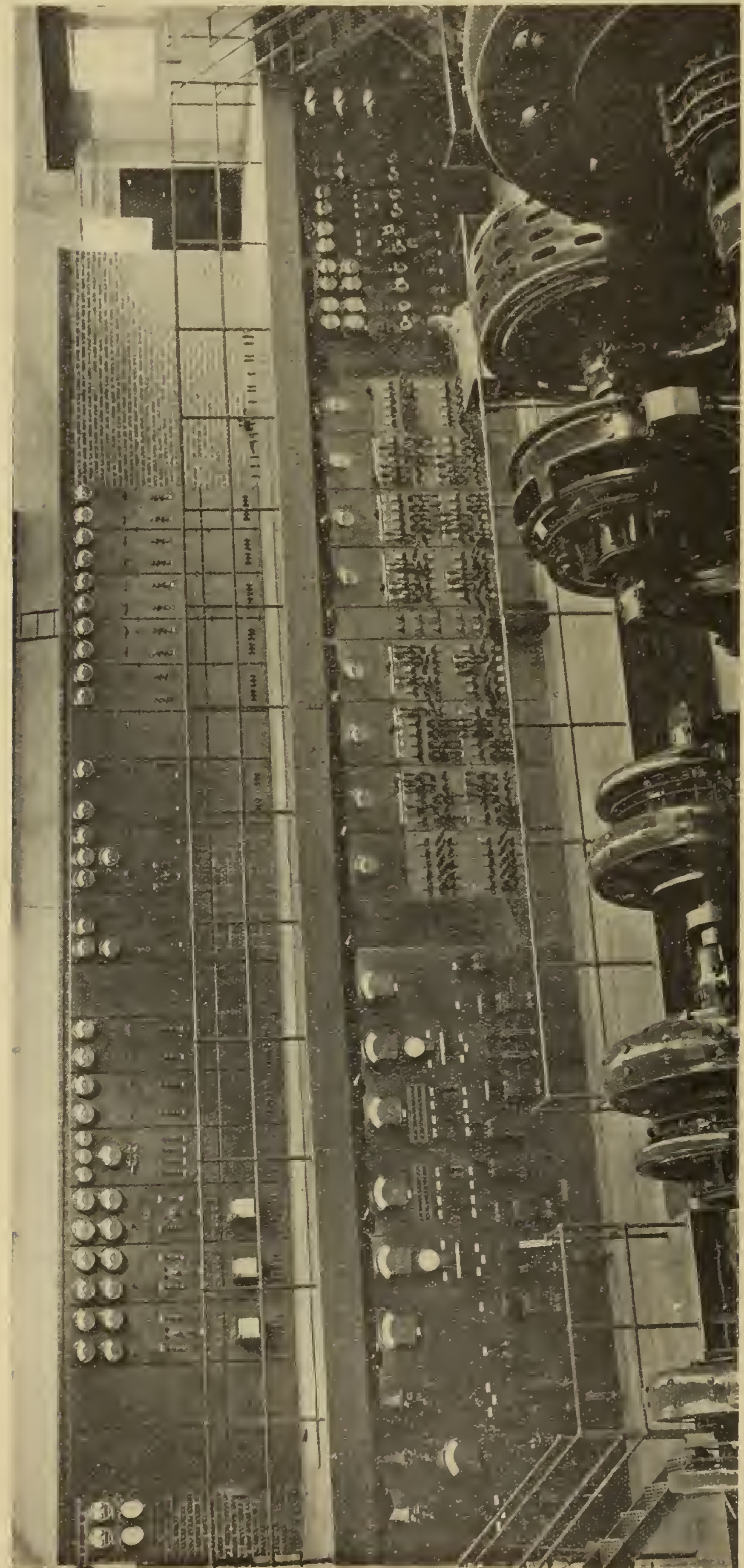
The High Capacity Runner, and the Vertical, Single Runner Turbine

Until two years ago, a very large majority of turbines applied to low heads were either of the vertical shaft, multi-runner type, or of the horizontal shaft, multi-runner type. The reason for using more than one runner on the shaft which, from a mechanical standpoint, is not desirable, was that this arrangement, permitted high rotational speeds, and, therefore, economic sizes of generators.

During the past two years, however, the general adoption of the single runner, vertical shaft turbine for low and medium heads, has been witnessed. This change in the type of unit has been made possible by recent progress in the design and development of high capacity runners. Thus, for a given head and speed it is now possible to secure from a runner a greater output than was possible two or three years ago; or, conversely, for a given head and capacity it is possible to operate the more recently designed runners at a much higher rotational speed than was the case with runners designed a few years ago. This increase in the capacity of runners has been secured without a sacrifice of maximum efficiency and with only a small sacrifice in the efficiency at fractional loads.

(To be concluded in Feb. 15th issue)

Modern Switchboard Practice at its Best



The new switchboard recently installed by the Toronto Electric Light Company, at their Scott Street station and illustrated herewith represents the latest and most approved practice in switchboard design, construction and installation. That part of the switchboard installed in the gallery as shown in the upper part of the picture represents the 12,000 volt remote control which controls all feeders, turbines and converter sets. On this board, along with the usual equipment of switches and instruments, green and red lamps are installed on each circuit, the green indicating that the circuit is open, the red that the circuit is closed. An interesting and valuable feature in this connection is a dummy bus panel occupying the lower part of two of the panels near the centre of the board on which the bus structure, switches and lamps are represented in miniature, giving the operator, at a single glance, a knowledge of the condition of the complete system. Directly behind the brick wall shown are the 12,000 volt switches which board controls, and below on the ground floor are the main 12,000 volt bases and 12,000 volt type H3 oil switches.

The lower board controls all 230 volt d.c. buses. Of this board the first nine panels on the left are for the control of the storage battery sets. The tenth panel controls the station lighting and auxiliaries. The next four panels control 40 positive feeders. As these panels have a width of 30 inches it will be seen that by grouping the positive feeders together it has been possible to economize greatly in the length of board as two feeders occupy only six inches in length. The close proximity of these feeders detracts nothing from their absolute safety as they are all of the same polarity and have the same voltage. So far as we can learn this is a unique practice in central station work in Canada.

The next or fifteenth panel from the left controls the circuit breakers on the net-work. These sectionalize the d.c. system into two sections, one feeding from this station and one feeding from the Terauley Street station, where this panel is duplicated for this purpose.

The next four panels control the negative feeders corresponding to the four positive feeder panels already described. As with the positive panels the same economy of space has been introduced with absolute safety.

The next panel is a blank and the five panels to the right are remote control machine panels arranged for two machines on each panel. The main circuit breakers and the main and auxiliary machine buses are located in the basement immediately underneath.

All wiring is carried in conduit set in the cement floors and the work at the back of the switchboard represents a piece of construction so well planned and executed that it must be seen to be appreciated. This work was carried out under the supervision of Mr. S. Bingham Hood for the company. The battery board was supplied by the C. G. E. Co. and the other boards by the Northern Electric & Mfg. Co.

Testing of Telephone and Telegraph Lines*

By Mr. T. H. Nicholson

In order to clearly follow the operation of a test circuit it is necessary to know the complete composition of the line or group of lines to be tested. All telephone lines must necessarily have some apparatus connected to them for signalling purposes, and of course some arrangement to remove this apparatus from the line when it is being used for transmission purposes. In some systems the signalling apparatus is also used for talking battery supply and for supervision, while in others the apparatus is removed by means of cut-off jacks. However, for the sake of simplicity we will here consider a system using a separate line and cut-off relay, the cut-off relay being actuated by the operator's cord circuit. This fulfils our earlier assumption of a three wire system and permits of better explanation and understanding of methods to be followed.

Fig. 23 shows the wiring in schematic form, omitting all cross wiring, etc., of a conventional subscriber's line of the type above spoken of, and while it does not conform to any definite standard, it resembles several systems enough to permit of readily applying the tests given with it to others.

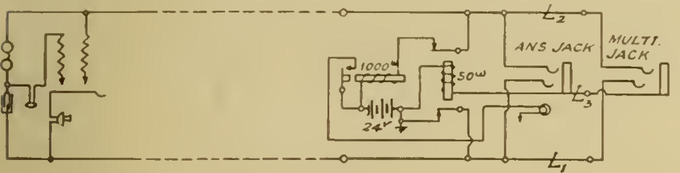


Fig. 23.

All tests will be assumed as being made from the multiple jack shown, and using the wires L_1, L_2 and L_3 to correspond with similar wiring in the test circuit. The third wire or L_3 should be connected from the central office battery through a resistance equivalent to that in the operator's L_3, so that the cut-off relay will be properly operated and the line apparatus removed.

To make a complete test of a subscriber's line it is necessary to make a definite number of tests in some order or another, and additional tests to locate trouble which may be found. For the present we will confine our attention to those necessary for a routine test, leaving trouble location to follow.

The required tests and their order may be as follows:

(1) Test line for continuity.
(2) Test instrument for capacity.
(3) Test sides of line for insulation.
(4) Test line and cut-off relays.

These four general tests require several functions of the test circuit each, and as a large number of these must be made it is desirable that they naturally follow one another in the key operation as far as possible. These functions may in turn be classed as follows, each item comprising a different arrangement of the test circuit:—

(1) Metallic line test for cross.
(2) Test of L_1 for ground.
(3) Test of L_2 for ground.
(4) Continuity of line and instrument test.
(5) Test of line and instrument for resistance.
(6) Test of L_3 for resistance.
(7) Test line relay, L_1 side.
(8) Test of line relay, L_2 side.
(9) Calling operator with test circuit.
(10) Calling operator through subscriber.

These ten functions will give a fairly complete routine test on a regular subscriber's line that has no special arrangement, and in an exchange where no unusual operation is followed.

The circuit shown in Fig. 24 is one designed to provide for all of the above under these conditions and of course can be extended to include additional tests as found necessary. It will be noted that the keys are all shown single, and that they are all arranged in an order that seems fortunate for ease in wiring. They are shown in this manner, however, in order to make the circuit more easily understood. Any kind of keys that will give the necessary operation will do, and further they may be combined into double keys if desired, always considering the operation, however, and whether any two functions in question will ever need to be operated together.

Explanation of Circuit

Referring to the figure, it will be noted that the voltmeter is already connected through the test battery on to L_1 and L_2, so that no operation is necessary for this feature. Key No. 1 opens L_1 and grounds the test battery, thereby providing for a test on L_2. Key No. 2 reverses L_1 and L_2, and grounds the L_1 side of test circuit and permits of testing L_1. Key No. 3 simply reverses L_1 and L_2 for any test requiring such reversal. Key No. 4 is a ringing key, simply opening the test circuit and ringing out. Key No. 5 bridges the telephone across L_1 and L_2 for talking purposes. Key No. 6 provides talking battery on the line, for use on common battery instruments. Key No. 7 reverses L_3 and L_2, and grounds L_1, thus giving a test of L_3. Key No. 8 opens L_3, to permit operation of cut-off relay, and puts a coil across L_1 and L_2 to operate the line relay. Key No. 9 opens this coil when key No. 8 is operated, and also opens transmission circuit, so that tester can monitor on lines without interferring. Key No. 10 shunts the voltmeter, and key No. 11 opens the voltmeter battery circuit, and closes the voltmeter direct on the line for measuring other currents.

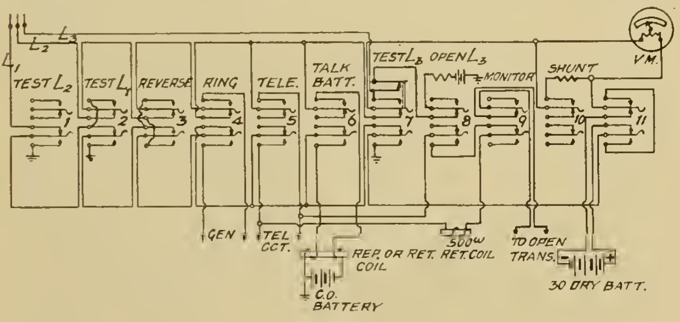


Fig. 24.

A very satisfactory street lighting system has been installed in the town of Taber by the Canada West Coal Company, Limited, which company supplies power and light throughout the town. This company operates two 150 kw. direct current Goodman generators and a 150 kv.a. Electric Machine Company alternating current unit all operated by Ideal steam engines. The street lighting system in the business section consists of 30, 2-arm iron brackets each carrying two 100 watt lamps. In the residential section 100 Cutter boulevard brackets with single lights have been installed, so that for a town the size of Taber this represents a very satisfactory illumination.

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Electric Railways

Statistics and Prospects in the Canadian Electric Railway Field — The Past Year One of Marked Progress — The Present Year One of Great Promise

In looking over the electric railway situation in Canada at the present time one is forcibly impressed with the evidence that we are on the threshold of a great development. Up to the present time electric operations have been confined more or less to cities and large towns and little attention has been paid to interurban work, this being left to the slower and more unwieldly steam railway systems. Present indications are, however, that the next few years will see a decided change in this situation. During the past year a very noticeable advance is shown in the decision of the C. P. R. to electrify the mountain section of their branch between Rossland and Castlegar, and in the work undertaken by the C. N. R. in tunnelling through Mount Royal and equipping their Montreal terminals electrically. Both of these equipments call for operation at 2400 volts which becomes a record in Canada. In this connection it is pleasing to note that Canadians are leading in the matter of high voltage railway electrification in that there is only one system operating at this voltage on the American continent and the second and third systems will be those mentioned above. Contracts for the fourth 2400 volt system have since been let in the United States. These systems cannot, of course, be considered as strictly interurban lines as the traffic requirements will be very heavy.

As indicating the tendency in purely interurban construction it is, however, interesting to note the decision of the Toronto Suburban Railway Company to operate their new western line at 1500 volts d.c. A contract was recently awarded to the Canadian General Electric Company for the complete construction apparatus and car equipment for the new line of this company which will run west from Toronto through Georgetown to Guelph and later to Berlin. This is the first interurban line in Canada which will operate at 1500 volts d.c. The catenary type of overhead construction will be used and there will be three sub-stations in this distance, namely, at Islington, Georgetown and Guelph. 1500 volt rotary converters of 500 kw. capacity each will be used, power being transmitted to the sub-station at 25,000 volts. The cars will be equipped with four 85 h.p. motors of the latest type, fully ventilated; the control will be of the multiple unit type to permit of train operation. These cars will be capable of operation at 600 volts at approximately half normal speed and the motors will be so designed that the change from the higher to the lower voltage, and vice versa, can be made as conditions demand. The 1500 volt line project will be about 62 miles long. Provision will also be made along this line for the supply of power, by the installation of a separate bank of transformers in each sub-station. This power will be distributed for miscellaneous power and lighting purposes.

Possibly the promise of greatest development in the near future lies with the Hydro-electric Power Commission of Ontario. The engineering department of the commission has been quietly but very vigorously engaged in the collection of valuable and accurate information on the railway possibilities in many different sections of Ontario. Surveying parties have been constantly at work and information of a most accurate and complete character has been compiled wherever it has seemed possible that a railway system was likely to be required, or, if required, to be a feasible proposition. At the present time information of this character is on file at the commission's offices covering some 400 miles of possible lines and in the near future this information will be supplemented by similar data covering another 200 miles.

The districts projected already include the Markham, Whitby, Port Perry and Uxbridge section, approximately 80 miles; a network of lines covering Huron County aggregating approximately 215 miles; a projected line from London to Sarnia of 88 miles; a line from Stratford to London by way of St. Marys of 36 miles; and a line connecting St. Thomas with Windsor, something over 100 miles, making a total of over 600 miles. In addition to this, requests have come in from other sections and information will be gathered in due course. With this data ready, the commission will await only the authority of the municipalities to proceed with the work.

A noticeable change has taken place in the attitude of the Hydro Commission towards the construction of electric railways in that the apparent apathy of a year ago has given place to an almost enthusiasm in the belief of the possibility of many of these lines to become a financially paying proposition. In a number of sections surveyed it has been shown that the passenger traffic can be very largely supplemented by the carrying of farm produce and freight in its many different forms, and this feature is particularly applicable in the better farming districts. The most progress appears to have been made in connection with the Markham district and a printed report was issued some little time ago covering the estimates for railway lines in this vicinity. The report states that a 2400 volt direct current system has been used in figuring the cost of the electrical equipment but that the layout and traffic should give similar results with a single phase a.c. or 1200 volt direct current systems. The report goes on to say that while these systems will be more expensive in first cost and operating expenses for a short line than the low voltage direct current system, that has been so long standard in Canada, they are necessary for a line of this type in order that holiday or special traffic may be properly handled without the capital cost being raised to an amount that would cause unusually heavy expense for normal operation. These systems have also been chosen, the report states, in order that the line may be able to take care of freight traffic and to be extended short distances without installing additional sub-station equipment and trolley feeders. In the Markham district five schemes have been suggested which vary in total capital cost per mile from $49,800 to $41,300, the shorter schemes working out, of course, the most expensive. This would be reduced in each case by $6,500 per mile, as the government has promised to subsidize the roads to that extent.

The electrification of the London & Port Stanley, a steam road owned by the municipality of the city of London, and at present operating as a steam line, has been decided on during the past year. Engineering features, if determined, have not yet been made public but it is understood that work will proceed early in the present year and that the work of electrification will be completed, if possible, before the year is out.

Among other noticeable features of the year may be noticed the very rapid growth in popularity of the p.a.y.e. type of car which is now being used almost universally. The gas-electric has not made as rapid progress as might have been anticipated. One car of this type is now operating out of Edmonton and two on Vancouver Island in addition to the pioneer car operating on the Quebec and St. John Railway. With the larger extensions in the interurban field this car may look for greater popularity. It has been announced that the Ottawa & Morrisburg line will probably be equipped with this type of car; also the Lacombe and Blindman Railway.

Another sign of the times is the decision of the Dominion Power & Transmission Company to build a large auxiliary steam plant so that they may be in a position to guarantee continuous service at all times.

Among the smaller enterprises the street railway for Stratford which seemed possible a year ago now looks to be farther in the future than ever. The Medicine Hat system is held in abeyance until certain legal questions, now pending, can be settled. The Grand Valley Railway and the Brantford Street Railway are still in the hands of a receiver, and it seems most probable that the Brantford end of it at least will be taken over by the municipality. The Three Rivers city line as well as radial lines in the vicinity are still in the future. The Forest Hill line which was to operate in the immediate vicinity of North Toronto has made no move as yet towards construction work. The Ottawa, Rideau & Kingston have made no report of progress. The Humber Valley railway is also held over, and the same is practically true of the Toronto Eastern. Among the newer promotions may be mentioned the Quebec & Isle of Orleans; the Sudbury, Copper Cliff Surburban; the London, Grand Bend and Stratford; a private system in Prince Albert, Sask.; the Imperial Traction Company; Estevan Transit and Power Company; Suburban Railway Company, St. John, N.B.; and the Alberta Metropolitan Railway Company. Work on any or all of these, however, may be pushed forward during the present year.

Brief notes on the operation of the different Canadian companies with their prospects for the coming year are given below. On account of financial conditions many of the companies are reticent about expressing themselves on probable extensions during 1914, but enough information is given to show that a tremendous amount of work is under contemplation.

It is now reported that Sir Donald Mann has stated that work on the branch railroad line from Kamloops to Vernon and south down the Okanagan Valley will be started in the near future. Sir Donald is stated to have said that this line will be electrified, power being obtained by a development at Couteau Falls.

A further item of interest to electric railway men is the entrance into the manufacturing field of the Tillsonburg Electric Car Company; also, for a certain class of railway car, of the Canadian Car & Foundry Company. It has been noticeable on different occasions that our railways have found it necessary to go outside of Canada for their rolling stock and other equipments and with the certain increased activities of the near future there will be more than enough orders to go round. The awarding of contracts for new cars in the recent past has been largely determined by the ability to make delivery.

British Columbia Electric Railway Co.

This company has still much the largest system of lines in Canada with a total mileage at December 31, 1913, of 370.09. During the past year the lines around Vancouver city were extended by the addition of some ten miles, but a larger development was shown on Vancouver Island where the Victoria city system was extended up the Saanich penisula some 26 miles, opening up a very rich agricultural and summer resort district. During the year the company have added to their rolling stock three double track passenger cars built in their own shops, 60 freight cars, 3 sweepers, 15 logging cars and two combination passenger and mail cars. The total equipment at present consists of 902 cars.

Berlin & Waterloo Street Railway

This company has added two 45 ft. double truck passenger cars during the year and one and three-quarter miles of track. During 1914 they will extend their track by another mile and add another double truck car.

Brandon Municipal Railway

Two miles were added during 1913 and ten single truck cars, ten trailers and a snow sweeper were put on the lines; these representing the total rolling stock to date. It has not been decided yet what extensions either of rolling stock or of track will be made during 1914.

Calgary Municipal Railway

This system added 10½ miles during 1913, bringing the total up to 70 odd. They also added during the year 12 41-ft. and 12 46-ft. motor cars and 6 40-ft. centre entrance trailers, bringing the total rolling stock up to 84. During 1914 at least five miles of track will be laid and 6 more 41-ft. cars will be placed on the line. Calgary now has more mileage per thousand of population than any city in Canada, having 70.5 miles to a population of approximately 85,000 or almost a mile per thousand people.

Cape Breton Electric Company

This company controls the Sydney & Glace Bay Railway Company, and altogether about 32 miles of line is operated. During the past year the Sydney & Glace Bay Railway Company have added three double truck cars and at the present time are installing two synchronous motor generator sets of 300 kw. capacity.

Chatham, Wallaceburg & Lake Erie Railway Co.

No extensions either to track or rolling stock were made during the past year. Two K11 Westinghouse controllers with the necessary switches and circuit breakers were installed.

Dunnville, Wellandport & Beamsville Electric Ry. Co.

Sixteen miles were under construction during 1913 from Dunnville to connect with the Canadian Pacific Railway at St. Anns. It is expected this will be placed in operation during the present year and the line extended on to St. Catharines. On this 16 miles the grading is pretty well completed and all bridges are finished; part of it is tied and ready for steel rails.

Dominion Power & Transmission Company

This company controls the Hamilton Street Railway Company, the Hamilton & Dundas Street Railway Company, the Hamilton Radial Railway Company, the Hamilton, Grimsby & Beamsville Electric Railway Company, and the Brantford & Hamilton Electric Railway Company. Eight miles were added to the Hamilton Street Railway and 12 double and 12 single truck cars during the past year. No additions were made to any of the other lines. The Hamilton & Dundas now consists of 7 miles of track, the Hamilton Radial of 32 miles of track, the H. G. & B. of 23 miles, and the B. &

H. of 23 miles. In addition the parent company controls the Hamilton Terminal Company, which owns a considerable amount of rolling stock. The total rolling stock of this extensive system is some 180 cars of all kinds.

Edmonton Radial Railway

Very extensive development work was carried on by the city of Edmonton during the past year which consisted in track extensions to the amount of over 20 miles, and additions to rolling stock of 32 cars. At the present time the city operates about 53 miles of single track and 79 cars of all sorts. During 1913 new car barns and shops were completed at a cost of $250,000 which are thoroughly equipped with modern machinery so that the department can make all necessary repairs to railway stock. During the present year it is not expected that as much extension work will be undertaken. At least 7 passenger cars will be required, however, and an amount of track work will be carried out which has not yet been determined.

Edmonton Interurban Railway Company

Nine miles of interurban line were completed during the past year, connecting Edmonton with St. Albert. On this line one gasoline electric car is operating at the present time and we understand two other cars of similar type and one work car will be added to the rolling stock during the present year. Three miles of additional track will also be required.

Fort William Electric Railway

The Fort William Electric Railway and the Port Arthur Electric Railway, which were formerly operated under a combined management, have now been divorced and will continue operation as two entirely separate systems, though certain arrangements will allow for a through service between the two cities. The city of Fort William operates at present about 12 miles of line and it is expected that a belt line of about four miles will be added during 1914. It is also the intention of this municipality to add to their rolling stock five single truck, double end, p.a.y.e. cars, now on order, and one snow sweeper, also on order. The rolling stock at the present time consists of 17 double truck motor cars, two single truck motors and three double truck trailers. A considerable sum of money was spent during 1913 on car barn additions.

Grand Valley Railway Company

This company, which operates between Galt and Brantford, also controls the Brantford Street Railway system. The company's affairs have been in the hands of a receiver during the past year and it is not yet determined what will be the outcome of certain points at issue between the city of Brantford and the company. Present indications are that the city may take over the system and operate it municipally, that part at least which is within the city limits.

Guelph Radial Railway

This company has added a double end, double truck, p.a.y.e. car to the rolling stock, which brings the total to 17 cars of all kinds. During the next year two double and quadruple equipment p.a.y.e. cars will be added.

Halifax Electric Tramway Company

During 1913, six closed cars and a little over two miles of line represent the extension work of this company. The total trackage is now approximately 22 miles with 60 cars.

Hull Electric Company

1.4 miles, bringing the total to 28 miles, were added during the year and 4 trailer cars, now on order, will be added to the rolling stock during the early part of the coming summer. During the present year track extension work will consist of double tracks on certain of the city streets and certain other extensions to the city lines, but no definite decision has yet been reached as to the extent of this work.

International Transit Company

During the past year this company extended their line by approximately one-half mile. The rolling stock now consists of eight motor cars and three trailers and two motor cars will be required during the present year, though it is improbable that further track extensions will be made at present.

Kingston, Portsmouth & Cataraqui Electric Railway Co.

The present eight miles of line will be extended by one-half mile during the coming summer. The rolling stock consists of 20 passenger cars, 2 sweepers and 1 work car.

Lacombe and Blindman Valley Railway

According to latest reports good progress is being made with the survey and grading of this road, which will run from Lacombe, through Gull Lake and along the Blindman river valley. It is said 100 men are at present at work.

Levis County Railway

The trackage consists of 12 miles and the rolling stock of 22 cars. No extensions have been made during the year.

London & Lake Erie Railway & Transportation Co.

During the past year this company have changed over from their own steam power plant to Niagara power supplied by the Ontario Hydro Commission. During the present summer they expect to extend their line by some 30 miles, which will more than double their present system. During the past year two baggage and express cars were added to the rolling stock. It is unlikely that additional rolling stock will be purchased during the present year though this will be necessary as soon as the proposed extensions are built.

London Street Railway Company

The total length of track now stands at 35, being increased by one mile during the past year. The rolling stock has also been increased by 6 single truck p.a.y.e. type cars, one of which was described briefly in a recent issue of the Electrical News. It is improbable that extensions either to rolling stock or track will be undertaken during 1914. The total rolling stock consists of 60 cars of various types.

Lethbridge Municipal Railway

It has not yet been determined what extensions will be made either in trackage or in rolling stock during the present year. At the present date ten cars are operating on 10½ miles of line.

Montreal & Southern Counties Railway

This company is rapidly extending its line as is shown by the 22-mile addition during 1913, with 24 miles more to be completed this year. The present mileage is 32, which at the end of the present year's operations should be 56. During the year 6 passenger, 2 combination express and passenger and one double truck sweeper have been added, and during the present year 10 passenger and 2 express cars will be required.

Moose Jaw Electric Railway Company

This company added five miles of track during 1913 and will complete another five miles this year and bring the total mileage up to twenty. Fourteen single truck p.a.y.e. cars were added in 1913, bringing the total rolling stock to 22 and 1 sweeper. This company use Diesel oil engine generating equipment and will install another 500 h.p. unit during the year. In 1913 a 500 h.p. unit was installed and the new unit will be a duplicate of this one.

Morrisburg & Ottawa Electric Railway

Ten miles of grading are practically completed by this company and during the present year it is hoped this will be extended to 25 miles, and placed in operation. Rolling stock requirements will therefore be considerable and will consist of three locomotives and 20 other cars for use during construction and of 6 passenger and 20 freight cars for operation of the line when completed. It is the present intention to use either gas-electric cars or gas-electric in part and straight electric in part. A right-of-way has been secured for the entire route. At the recent January elections the village of Chesterville voted a bonus of $5,000 to cover extensions through that village and a year ago the city of Ottawa voted them terminal rights in Ottawa. At the present time bonds to the extent of $1,000,000 are being placed on the market to take care of further operations.

Moncton Tramways, Electricity & Gas Co.

This company now operate five miles of line, one mile being completed during the past year. Considerable extension work will be done in 1914, consisting of from two to four miles of track and the company will require four or five new single truck cars for passenger service. New generating equipment will also be required and it is likely this will take the form of a 300 kw. a.c. unit and a 150 kw. motor-generator set. The company will also install high pressure boilers in place of the low pressure tubular boilers now in use though it is understood these changes will not take place until somewhat later in the year.

Nelson Street Railway

The Nelson railway system has now been taken over by the city and will be operated as a municipal enterprise. Three cars are operating on about 1½ miles of line, but during the present year it is the expectation that some additions will be made to both track and rolling stock.

Niagara, St. Catharines & Toronto Railway Company

An extension from St. Catharines to Niagara-on-the-Lake has been completed and recently placed in operation, adding 12.2 miles to this company's lines which now total 76 miles of single track. During the year four semi-convertible passenger cars, one electric locomotive and one snow sweeper were added to stock and during the present year six interurban passenger cars, already under order, will be placed in operation. A sub-station will be placed at Niagara-on-the-Lake to feed the extreme section of that line. The total rolling stock comprises 42 passenger cars, 36 freight, 6 miscellaneous and 6 locomotives.

Niagara Falls, Welland & Lake Erie Railway Company

This road is now operating 3 single truck cars and 1½ miles of line and it is expected that the mileage will be increased this year by the addition of 2.8 miles. Probable requirements in rolling stock include 1 single truck car and 2 interurban cars. A new 300 kw. rotary converter with necessary transformers, switches, etc., will also be purchased.

Nipissing Central Railway Company

No extensions to this line have been made during the year, but it is expected Cobalt will be connected with Kerr Lake by a 4-mile line during the present summer. This will bring the total of the system to about 15 miles. One combination motor, and snow plow were purchased this year and two interurban cars will be required for the additional line. There are at present six interurban passenger cars operating.

Oshawa Railway Company

One-half mile of siding was added during 1913 and only similar work will be carried on during the present year. The company has at present on order a new motor-generator set which it is expected will be operating within the next few weeks. Two closed passenger cars were added during the year. This company does a considerable amount of freight carrying.

Ottawa Electric Railway Company

Five miles of single track were added last year, bringing the total to 55. Twenty double truck steel cars, p.a.y.e. type, 45 ft. 3 in. long, were added to rolling stock as were also two double truck locomotive type sweepers. No extensions to the line are being considered for 1914 and track work will be confined to renewals. The rolling stock will be added to, however, by ten double truck steel cars similar to those added in 1913. The rolling stock of the company at present consists of 176 cars, 13 sweepers and 3 wing plows. The type of plow used by this company was illustrated in the January 15 issue of the Electrical News. During 1913 two sub-stations were erected and placed in operation, each containing 1—500-kw. Westinghouse motor-generator set.

Peterboro Radial Railway Company

One-quarter of a mile of track was rebuilt last year and the total trackage now stands at something over six miles. It is expected that one mile of this will be rebuilt during 1914. During the year two 9-bench open trailers were added to stock which now consists of nine semi-convertible cars and five trailers.

Port Arthur Municipal Railway

The municipality of Port Arthur built approximately five miles of line in 1913, bringing their total up to between 17 and 18 miles. Six cars were added during the past year so that the total is now 21 and two more cars are on order. At least one-half mile of line will be constructed this year but the plans are not yet complete.

Pictou County Electric Company

9.1 miles of track are now operated by this company, 1 mile having been added during the past year. The line will be further extended this year about 1 mile. Three passenger cars and one snow plow have just been added, and additional rolling stock to the extent of two passenger cars will be required in the near future.

Quebec Railway, Light, Heat & Power Company

About two miles have been added to the city division of this company during the past year, bringing the total to approximately 24 miles. No rolling stock has recently been added and it has not yet been decided what extensions will be required for the present year. The total passenger rolling stock consists of 11 cars. No changes have been made on the Montmorency division.

Regina Municipal Railway

This system is developing very rapidly, 21 miles being constructed during the past year, which brings the total to 30 miles single track. During the year also six double truck passenger cars, six single truck passenger cars, and one motor haulage car were added, which with one single truck sweeper, one double truck sweeper, six dump cars, five flat cars and eighteen garbage cars now comprise the total rolling stock. During 1913 there were four miles of single track reconstructed from gravel ballast to permanent paved track. Further extensions to the amount of three miles will be added this year, also a sprinkler and six double truck passenger cars.

Saskatoon Municipal Street Railway

This municipality now operates 15 miles of line, the year's additions consisting chiefly of a line connecting the city of Saskatoon with Sutherland, a village three miles distant. This line was built by certain real estate interests and handed over to the city of Saskatoon for operation. It is the intention to maintain a half-hour service on this line, operating two cars. In 1913 six double truck passenger cars were added and during 1914 another half dozen trucks will be required and certain line extensions not yet decided upon will be made. A 500 kw. rotary converter will be added to the generating equipment.

Sarnia Street Railway Company

No extensions were made during 1913 but about one-half mile of track is to be built this year. Ten cars are operating on 9¼ miles of track.

Sandwich, Windsor & Amherstburg Railway

One and one-half miles built in 1914 brings the total of this company's line to nearly thirty miles. Four single truck p.a.y.e. cars were added to rolling stock which now totals 53 cars. During the present year two double truck cars and two single truck cars will be added to rolling stock and three miles of track will be built. This company operates the Windsor & Tecumseh Electric Railway, which has single track in addition to the above of approximately ten miles.

St. John Railway Company

The city of St. John is showing very satisfactory evidence of industrial activity. During the year the railway company added 1½ miles to their line and next year will complete another three miles of track. Thirteen cars were added during the year and six more will be added. The total rolling stock now includes 38 closed, 25 open and 1 work cars, 3 plows and 4 sweepers. An addition is being made to the generating equipment by a 2,000 kw. steam turbo-generator, which is at present being installed.

St. Stephen Electric Railway Company

This road is leased and operated by the Calais Street Railway of Calais, Maine. The system consists of only three miles.

St. Thomas Municipal Street Railway

No additions have been made either to track or rolling stock and it is not yet determined what extensions will be made during the present year. Seven miles of track are operating.

Sherbrooke Railway & Power Company

No extensions to track or rolling stock have been made recently and it is not yet settled what work will be done this year. The company operates 11 miles of track with 19 cars, 1 sweeper and 1 plow.

Toronto Railway Company

About two miles of track were added last year, consisting of cross-town lines designed to relieve the congestion in the neighborhood of King and Yonge. The total single track now operating is approximately 121 miles. During the year 100 new cars were added to rolling stock bringing the total, including motors and trailers, to something over 1,000 cars. It is not probable any considerable extensions will be made this year pending the negotiations with the city of Toronto.

Toronto & York Radial Railway Company

No additions have been made to track or rolling stock during the past year though considerable extension work has been done. in connection with the distribution system maintained by this company in the towns and municipalities north of Toronto. A very efficient system of street lighting and power supply has been installed in the town of Aurora, and at the present time equipment for their waterworks is being installed. The company operates in all 82 miles of line with 91 cars.

Toronto Suburban Railway Company

During the past year an extension to Woodbridge was about completed and will be placed in operation this spring. This extension consists of approximately seven miles, which will bring the total mileage up to twelve. During the year four passenger cars were added and the total rolling stock is now 14 cars. During the year a considerable amount of grading was also done on the extension of this line west from Lambton to Georgetown to Guelph. From Lambton to Georgetown is approximately 26 miles and from Georgetown to Guelph 20 miles. As stated elsewhere in this article it is the intention to equip this line, with a further extension to Berlin, with 1500 volt apparatus. It is probable that during the present year three sub-station equipments will be put in and that at least ten new cars will be required in addition to other electrical equipment for building at least 46 miles of line.

Toronto Civic Railway

The municipality of the city of Toronto now operates 16.84 miles of track, having added 4 miles during the past year. The total is made up as follows:—Gerrard St., 3.66 miles; Danforth Ave., 6.82 miles; St. Clair Ave., 6.36 miles single track. The total rolling stock now consists of 20 double end control, 4 motor equipment, centre aisle, p.a.y.e. cars, 44 ft. 5 in. over all, and 1 sweeper. A quantity of construction work is under prospect for the present year but nothing has been decided.

Windsor, Essex & Lake Shore Railway

No additions to track were made last year so that the mileage still stands at 38. It is expected two passenger cars will be added to rolling stock during the present year.

Winnipeg Electric Railway Company

This company controls also the Winnipeg, Selkirk & Lake Winnipeg Railway and the Suburban Rapid Transit Railway. The Winnipeg Electric Railway Company proper have added to their rolling stock 40 motor cars, 2 flat cars, and 1 trailer. The total mileage is now 100 and the total passenger rolling stock 340. The Winnipeg, Selkirk & Lake Winnipeg Railway added 8 miles of track during the year and now operate 32 miles. The Suburban Rapid Transit Company operates 19.6 miles. No decision has yet been reached as to the extensions to any of these lines during the coming year.

Yarmouth Electric Light Company

This company operates 4 miles of track and during the year added two single truck and two motor cars to their rolling stock. The railway is operated by a synchronous motor-generator set situated in the town sub-station supplied by power brought 18 miles from Carleton over a 22,000 volt transmission line.

Summary

	No. miles added 1913	Total miles	No. miles to be built 1914	No. new cars 1914
Berlin & Waterloo	1.75	5	1	1
Brandon Municipal.	2	8	..	..
Brantford & Hamilton	....	23	..	..
B. C. E. R.	36.07	370.09	..	..
Cape Breton Electric	....	31.5	..	..
Cornwall Street Railway Co.	....	31.5	..	..
Calgary Municipal	10.5	70.5	5	6
C. W. & L. E.	....	40	..	..
D. W. & B.	....	....	16	..
Edmonton Municipal	20.3	52.6	..	7
Edmonton Interurban	9	9	3	3
Fort William Municipal	....	12	4	6
G. P. & H.	....	22	..	..
Guelph Municipal	....	8.5	..	2
Grand Valley	....	47.4	..	..
Hamilton Street Railway	8	26	..	..
Hamilton & Dundas	....	7	..	..
Hamilton Radial	....	32	..	..
H. G. & B.	....	23	..	..
Halifax Electric	2.1	21.6	..	..
Hull Electric	1.4	27.9	..	4
International Transit	.5	4.1	..	2
K. P. & C.	....	8	.5	..
Lethbridge Municipal.	....	10.5	..	..
Levis County.	....	12	..	..
L. & L. E.	....	29	30	..
London	.7	35	..	..
M. & O.	10	..	25	29
M. & S. C.	22	32	24	12
Moose Jaw	5	15	5	..
Montreal Tramways	....	240	..	..
Moncton Tramways	1	5	4	5
N. F. P. & R	....	24.5	..	..

N. S. & T.	12.2	76	..	6
N. W. & L. E.	.85	1.52	2.8	3
Nelson Municipal	....	2	..	..
Nipissing Central	....	10.5	4	2
Ottawa Electric	5	55	..	10
Oshawa	.5	6.5	.5	..
Peterboro Radial	.25	6.1	1	..
Port Arthur Municipal	5	18	.5	2
Pictou County	.7	9.1	1	2
Quebec R. L. H. & P.				
City Division	1.9	23.9	..	..
Montmorency Division	....	28	.	..
Regina Municipal	21	29.75	3	7
Saskatoon Municipal	....	15	..	6
S. R. T.	....	19.6	..	..
S. W. & A.	1.4	39	2	4
St. John	1.5	20.5	3	6
St. Stephen	....	3	..	..
St. Thomas	....	7	..	..
Sarnia	....	9.3	.5	..
Sherbrooke	....	11	..	..
Toronto Railway	2	121	..	..
Toronto Suburban	7	12	46	10
Toronto & York	....	82	..	..
Toronto Eastern	20	..	..	..
Toronto Municipal	4	16.84	..	..
W. E. & L. S.	....	38	..	2
Winnipeg Electric	18	100	..	..
W. S. & L. W.	9.8	31.9	..	..
Yarmouth Street Railway	....	4	..	..
Total	241.42	2080.20		

Track Construction in Edmonton

During 1913 the city of Edmonton constructed 21.714 miles of electric railway. The construction used entirely last year was 80 lb. A. S.C.E. rails and granolythic construction between the tracks reinforced as shown in Fig. 1 herewith. The reinforcing consists of No. 10 gauge expanded metal 3-in. mesh, placed approximately 1½-in. below the upper surface of the concrete as indicated in this figure.

Fig. 1 may be said to represent the type of construction adopted by Edmonton during the past year as standard. The subgrade is prepared true to grade and the whole surface of the roadway is thoroughly consolidated by rolling with a ten-ton steam roller or, when inaccessible to the roller, by ramming. The first layer consists of a concrete base six inches in thickness of the proportion of one part cement, three parts sand and six parts crushed stone or gravel. When this concrete base is sufficiently set the city assembles and leaves to rough centre the skeleton track which includes ties, rails, fastenings, bond work and overhead work.

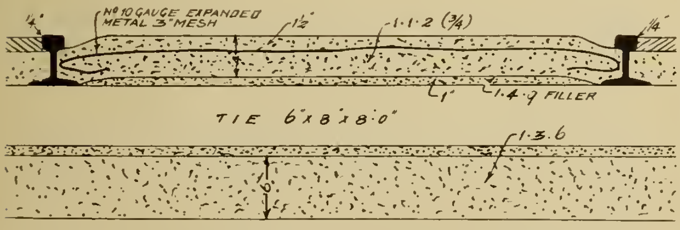


Fig. 1.—Standard construction in Edmonton.

Under each tie when the track is set to final grade and alignment the contractor next places a compact cushion, 1-in. thick, of clean, dry, sharp sand. There is then poured by the contractor a concrete filling of the proportion of one part cement, four parts sand and nine parts broken stone or gravel. Care is taken that the consistency of the filler shall be such that the sand cushion under the ties shall not be saturated. After pouring, the filler has an all-over contact with the ties and rails, the upper surface of the filler being approximately 1-inch above the tie level. The final filling between the gauge lines consists of a one to one to two mixture.

In the 1913 construction no crown has been given to any part of the roadway. Between the rails the concrete is finished flush with the top of the rails. On each side the concrete is depressed ¼-inch below this level.

Special Work

All special track work is of 7-in. high T construction with tadpole type switches. All this work is of the guaranteed manganese insert type with the exception of one grand union which was furnished by Hadfields, Limited, and is of solid manganese steel. The other special track layouts were manufactured by the United States Steel Products Company and consist for the past year of:—2 three-part wyes with through crossings; 8 three-part wyes; 1 two-part wye; 4 branch-offs; 1 single-track wye; 9 cross-overs; 2 45 deg. curves.

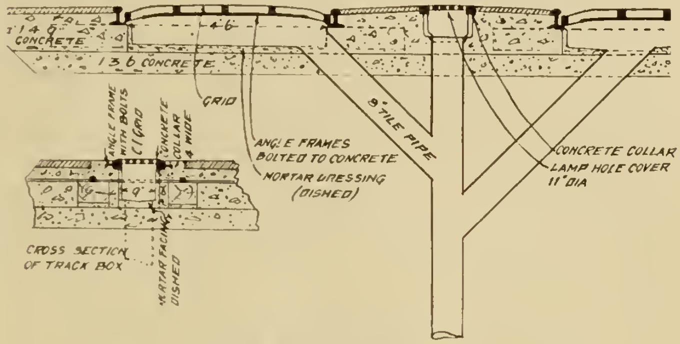


Fig. 2.—Track boxes on Edmonton System.

As will be seen from the foregoing the work is divided between the contractor to whom the work is awarded, and the city, as follows: the contractor is required to prepare (a) the grade; (b) the concrete base; (c) the sand cushion; (d) the concrete filler. The city supplies and leaves in place, to final grade and alignment, all track work which includes ties, rails, fasteners, bond work and overhead work. The contractor is paid for this class of work on the area basis.

At such points as are determined by the city engineer track boxes for drainage purposes are constructed according to the plan shown in Fig. 2. The contractor makes connections with the main sewer, constructs the track box and sets the cast iron grids to grade. This work is paid for at a unit price per box and a unit price per lineal foot of tile pipe installed.

The city constructs all pole work and overhead work prior to the skeleton track construction in order that power may be available for this work. In the case of centre pole construction the poles are erected after the subgrade has been prepared and before the concrete base has been constructed. The city undertake to do this work without undue inconvenience to the contractor and agree to sell power to the contractor for construction purposes.

Special provisions in the contract provide that all material must be so handled as not to obstruct the traffic.

The city of Port Arthur has just placed an order with the Ottawa Car Manufacturing Company for one single truck, double end p.a.y.e., double end control, street car and also an order with the Preston Car & Coach Company for three, double end, single truck, double end control, p.a.ye. street cars. These cars are to be delivered in six weeks and seventy-five days, respectively.

Illumination

Magnetite Arc Lighting in Lindsay

The city of Lindsay is one of the cities in the central part of Ontario served by one of the subsidiary companies of the Electric Power Company. It is located on the Scugog river, being on the Midland division of the Grand Trunk Railway and on the new line of the Canadian Pacific Railway to Port McNicol. In the past Lindsay received electric current from the old power house of the Light, Heat & Power Company of Lindsay which was located at Fenelon Falls. When the Light, Heat & Power Company of Lindsay was purchased by the interests controlling the Electric Power Company a new franchise was secured, and the latter company installed a transformer sub-station in the town, connecting it to the 44,000 volt transmission line of the Seymour Power & Electric Company. Arrangements were also made for switching and transformer equipment to be placed in the sub-station, so that it would be possible to parallel the Fenelon plant with the rest of the system. In this way absolute continuity of service was guaranteed to the citizens.

The main business street of Lindsay, viz.: Kent street, is one that the citizens are very proud of. It is 100 ft. wide building to building and 76 ft. wide curb to curb. During the past two or three years arrangements have been made with the Light, Heat & Power Company of Lindsay and with the Bell Telephone Company to have their poles removed from this street, and the only poles that remain standing on Kent street are those of the G. N. W. Telegraph Company, which it is hoped will soon be placed elsewhere. During the past summer the city put down a permanent pavement on Kent street, which made this street far more valuable to the city and to the merchants, whose places of business are located here.

Kent St., Lindsay, by day—Note absence of wooden poles.

At the time of deciding to place a permanent pavement on this street a desire was also felt that a change in the lighting scheme should be made. Up to this time Kent street was lighted with suspended type enclosed carbon arc lamps, and before any decision was arrived at, the councillors made trips to other installations so as to be in a position to decide on the very best type of lighting for Kent street. After looking over different types of illumination it was decided that the ornamental type magnetite arc lamps would give the most satisfactory results for the street.

Kent St., Lindsay, by night—Almost like day.

The equipment that has been placed in Lindsay is fairly standard for this type of illumination. The station equipment consists of a 25-light constant current mercury arc rectifier, using a single tube, which is placed in the old sub-station of the Light, Heat & Power Company beside the constant current transformers used for the rest of the lighting system. The line leaves the sub-station overhead and about one half a block distant on William street enters an underground system, at which point it is protected by lightning arresters.

In deciding on the type of underground system that should be used in Lindsay it was first thought that steel armoured cable, protected by a creosoted board and buried in the earth, should be used, but as the sidewalk was to be extended over the place where the cable was to be laid, it was thought that this type of installation might cause future expense and trouble in ripping up the pavement and defacing the street, should a cable puncture at any time. It was hence decided to use 2 in. fibre duct placed in concrete, the requirements calling for 3 in. of concrete on all sides of the fibre duct, the cable used being lead covered and paper insulated, the insulation being for 3300 volts. The foundations for the standards were used as pull-in boxes.

The standards used were steel standards of the Luxolabra type, and were of such a height that they placed the arc 14 ft. 6 in. above the walk. The lamps used were ornamental type magnetite arc lamps, Form 10, 6.6 ampere, using an alba globe. In each case an absolute cut-out was placed in the

A Lindsay Standard.

base of the standard, making it possible to trim or adjust any lamp at any time with perfect safety.

In designing the layout of the lamps on the street it was decided to place the lamps 165 ft. apart on the same side of the street, staggering the lamps on opposite sides, and thus bringing one lamp every 82½ ft. of roadway. This was done, so that, for the present, efficient lighting would be obtained, leaving room so that at any time in the future it would be possible to double the illumination.

The effect of this layout has been such that there is, practically speaking, no glare encountered in the street. The color of the light is pure white, and it adds greatly to the attractiveness of the street as a business district. The general illumination of the roadway is such that it is possible to read a newspaper in any part of the street, but at the same time the light is not so strong that it is uncomfortable. The general effect of the installation has been to greatly improve the street, making it attractive and giving the lighting a dignified appearance. The three objects that were sought for in the lighting scheme were:

1st. To be able to easily discern objects on the street.

2nd. To be able to easily discern unevenness of street surface.

3rd. To obtain a white way illumination without a bizarre effect.

The system was put into operation at 7.30 in the evening of November 29th—the first installation of ornamental magnetite arc lamps in Ontario. No great trouble was encountered in putting the system into service, and it has been in nightly operation since that date. It is not yet possible to give any definite data with regard to the features of operation, as it has not been in service long enough.

Figure 1 shows a view of one standard unit. Figure 2 gives a day view of Kent street; note the conspicuous absence of wooden poles. Figure 3 gives a night view of the street from the first storey of a building at the end of it. Differences in illumination of the surface are plainly seen from the night view, but this is not noticeable by one walking on the street.

The lamps and station equipment for this installation were supplied by the Canadian General Electric Company, the standards by A. H. Winter Joyner Limited. The engineering and construction work was under the charge of the engineering department of the Electric Power Company.

Night Photography

A long felt want in the photographic business has been a system of illumination which would enable the photographer to produce as good results on dark days or after night as under conditions of clear day light. With the developments in illumination, progress has been made steadily in the desired direction and installations have lately been made by the Canadian General Electric Company which are claimed to give as satisfactory results during night time as at any other time in the twenty-four hours.

After considerable experimentation this company have built up a certain combination of different types of arc lamps which they manufacture for this purpose. These lamps arranged in the form of an L and installed with the reflectors by the side of an enclosed white wall and suitably screened with prism glass and cheese cloth curtains have been found to give excellent results.

The light is of such a color that it is scarcely possible to notice any difference between it and daylight. This of course results in a total lack of eye strain and still the light is sufficiently intense on the plate and sufficiently rich in the necessary rays to produce a photograph with an exposure of the same duration as is given under the best daylight conditions in the same studio.

Quebec Water Powers

Two reports of the Quebec Streams Commission will be published during the present year. One of these deals with the studies of a general character carried out during the past year and the second will contain a review of the work done during 1913 in connection with the St. Maurice water storage proect. The aim of this commission is to improve the water powers of the province of Quebec by means of flow regulation and water conservation; also to encourage the development of the hydraulic resources in the province by private enterprise. The first report of the Commission, published November last, dealt with the conservation of water in a general way and also in a general way with the project for the storage of water on the St. Maurice River.

New Books

Handbook of Electrical Methods—McGraw-Hill Book Co., New York, publishers; price $3.00 net. This is a compilation of articles printed in the Electrical World from time to time during the last three or four years, of a type which relate purely to ways of doing things rather than of design, description of apparatus or of the commercial side of the electrical industry. It should therefore be of particular value to the practical man who is seeking that kind of information which is rarely obtainable from the average handbook. It is well illustrated and bound; 285 pages.

Personal

Mr. J. F. H. Wyse, consulting engineer, 34 Victoria St., Toronto, has been appointed organizer and engineer of the Ontario Safety League.

Mr. R. A. Lyons, for many years chief engineer of the London Electric Company, London, Ont., has resigned. The position will be filled by Mr. P. Wilkie.

Mr. Arthur Reid formerly superintendent of electric railways and electricity in Lethbridge, Alta., has been elected commissioner of public utilities for that city.

Mr. G. P. Cole addressed the Montreal Electrical Society on Monday, January 19, on the subject of transformers. At this meeting a resolution was adopted praying that the "City of Montreal employ resident engineers when engineering advice is required."

Mr. G. H. Stevens has resigned his position with the Toronto Railway Company to take up a position with the Canadian Niagara Power Company. Mr. Stevens will have charge of the entire secondary distribution system, etc., in the district of Fort Erie, Bridgeburg and Ridgeway and all work connected therewith, with headquarters at Fort Erie.

It has been decided to abandon the straight meter rate given in London by the municipal lighting commission up to the present time as an alternative. In future the universal charge for domestic lighting will be 4c per 100 sq. ft. plus 3c per kw.h. subject to a 25 per cent. discount. The commercial lighting and power rates have also been reduced considerably.

The Dealer and Contractor

Cost Calculation In Electrical Contracting

A paper containing valuable hints for the electrical contractor in general and especially for those of that calling who have not yet become habituated to the systematic conduct of their business was recently presented by Mr. Leo. Dolkart, section of that association with the electrical section of the Assoc. Mem. A.I.E.E., before a joint meeting of the Chicago Western Society of Engineers. The paper is valuable not only in that it discusses the essentials in the system of cost calculation, but in that a minimum of complicated calculations has been introduced. For this reason the ideas contained in the paper will be of value to the average electrical contractor who is not, for the most part, a very expert accountant. The paper follows:

"Hitherto it has been difficult to obtain data on costs and systems in contracting. This is especially true of the electrical contracting business. Contractors as a general rule are reticent in regard to the manner or method by which they arrive at their results. It is a fact, of course, that many contractors really have no method. The question with them is how close they can guess. At any rate there is a feeling among some contractors that if they happen to lose on one job the loss will be made up on the next one, since to them estimating represents a guessing contest. Of course, such contractors learn to their sorrow of the laws governing probability and chance. A feeling exists, too, that if one contractor devises some good system or an improvement in the method of doing business, there is a desire to "lie low"—to keep it from the "other fellow." It does not require much reasoning to see that such methods, as well as being out of date, are not productive of the best results. Co-operation and interchange of ideas between contractors will do much to uplift the profession and at the same time be of material benefit to the members thereof.

Estimating is, at its best, a very definite or indeterminate process, owing to the fact that so many variables make up the whole. Several of these, however, follow certain rules and may be more or less easily determined. In electrical contracting the material to be used on any particular job can be estimated to within a small percentage of that actually required. With the labor, it is an entirely different matter. Some of the variables to be considered in estimating the labor on any particular job are:

Season of the year the job is to be installed.

Rapidity of work of wireman A.

Rapidity of work of wireman B.

Rapidity of work of wiremen A and B when working together.

Section of state or country where job is to be installed.

It is hardly necessary to call attention to the fact that some work can be done more rapidly in cool weather than in warm weather, and vice versa. It is also true that if wiremen A and B are put to work together on one job, the net result will more often be less than the sum of the net results of both A and B, were the two working separately The net result may be also very different from that obtained by putting A and C or B and C together. The most economical combination can be determined only by trial.

That the section of the country where the job is being installed bears a certain relation to the rapidity with which the work will be completed is too self-evident a fact to need further elucidation.

One would at first imagine that with all these different items determined upon and the total material and labor estimated, it is an easy matter to arrive at the total cost of the job. Adding to the total the per cent. of profit would or should give the total amount of the bid. For illustration we will suppose a job X:

Material cost	$150.00
Labor cost	100.00
Total	$250.00
15 per cent. profit	37.59
Bid	$287.50

From the above it would appear that the job should net a very satisfactory profit of $37.50. Many contractors actually assume that $250 represents their actual cost on the above job. Really, however, such a cost system does not represent the true and accurate state of affairs. Expenses such as rent, telephone, light and power, office help, freight, etc., have not been considered. All such expenses coincident to the pursuit of the business make up what is termed the overhead expense.

It has been the practice, hitherto, of contractors taking care of the overhead to obtain the total overhead expense for the year, and, by dividing this sum by the total amount of business done during the year, obtain what is termed the percentage of overhead. That is, if the total amount of business for the year was $40,000, and the expenses for the year amounted to $8,000, the overhead would be 20 per cent. At first glance this would appear rather large for this amount of business, but actual facts as compiled from information supplied by contractors throughout the United States prove this percentage to be very low. As a matter of fact, for this amount of business it would be nearer 22 per cent. The percentage of overhead bears an inverse ratio to the amount of business done, and for a total year's business of less than $1,000 it amounts to about 45 per cent.

Taking the same example as considered in job X and applying the above rules, the cost would be as follows:

Material cost	$150.00
Labor cost	100.00
Total	$250.00
20 per cent. overhead	50.00
Actual cost	$300.00
15 per cent. profit	45.00
Bid	$345.00

It will be readily seen from the above that had the contractor taken the job for $287.50 he would not only not make any profit but would be an actual loser of about $12.50.

It is, of course, self-evident that the first method of figuring is entirely wrong. It is surprising that so many contractors do actually pursue such antiquated methods and are wondering why business seems to be unprofitable.

It is the aim of this article to prove that even the second method of figuring is wrong, in that the manner of obtaining the overhead expense is not strictly in accordance with the actual state of affairs. This can be readily seen from the following illustrations. Take two jobs whose total costs equal the same but with varying labor and material items:

Job A.		Job B.	
Material cost ...	$100.00	Material cost ...	$150.00
Labor cost	150.00	Labor cost	100.00
Total	$250.00	Total	$250.00

It is evident, of course, that job A will take one and a half times as long to complete as job B, but will, with the ordinary method of figuring, bear exactly the same percentage of overhead.

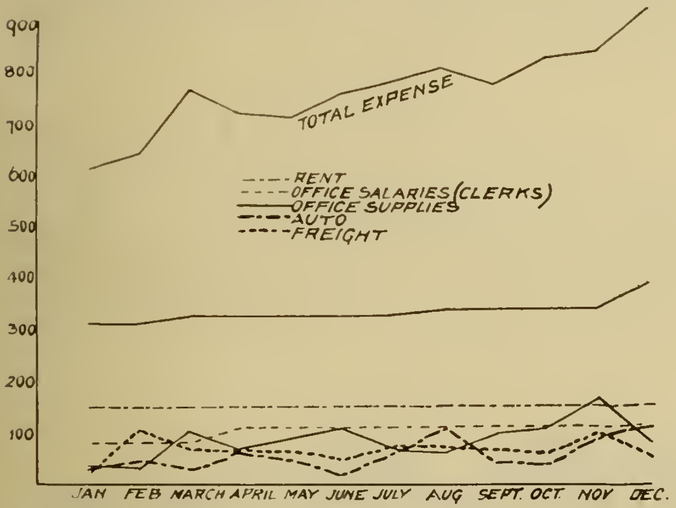


Fig. 1

If one stops to consider the components that comprise the "total overhead expense" one can readily see that most of these elements, rent, salary, telephone, insurance, etc., bear a certain relation to time. It is self-evident, therefore, that the total sum of these should also be proportional to time. In other words, if job A took one and a half months to complete, it would cost the contractor just one and a half times as much in labor overhead expense as job B, which took only one month to complete. Consequently overhead expense being proportional to the time element is proportional to the amount of labor, conveniently called "man hours."

It is apparent also that the cost of handling a job that takes a good deal of material is more than one that takes less material. It would appear, therefore, that in order to be just to the material and labor items, it would be necessary to divide the total overhead expense into two separate parts, one proportional to labor and the other to material. This the writer has applied to actual work and found to be very satisfactory.

The cost of doing business per "man hour" can be easily determined. In order to do this it is necessary to divide the total cost of doing business into two sets of expenses as shown below:

By dividing the total labor expense for the year by the total amount of labor hours, the overhead per "man hour" can be easily obtained. Dividing the total material expense for the year by the total amount of material handled will give the percentage of overhead for material.

Labor Expense	**Material Expense.**
Office rent.	Store room rent.
Office salaries.	Stock clerk's salary.
Telephone and telegraph.	Freight and hauling.
Light and power.	Fire and insurance.
Liability insurance.	Stock room supplies.
Office supplies.	Depreciation of furniture.
Depreciation of furniture.	Maintenance of wagon.
Depreciation of tools.	Depreciation of wagon.
Maintenance of automobile.	
Depreciation of automobile.	

Referring back to our two jobs and correcting the overhead we will find the following net results:

Job A.		Job B.	
Material cost ...	$100.00	Material cost ...	.$150.00
Material overhead, 5 per cent.	5.00	Material overhead, 5 per cent.	7.50
Labor cost, 300 hrs.	150.00	Labor cost, 200 hrs.	100.00
Labor overhead, 25c	75.00	Labor overhead, 25c	50.00
Total cost	$330.00	Total cost	$307.50
15 per cent, profit .	49.50	15 per cent profit .	46.13
Bid	$379.50	Bid	$353.63

Comparing these figures with our previous computations, it will be readily seen that if job A were taken for $345.00 it would not have proven very profitable. On job B the profit would be slightly greater than the original bid allowed.

The division of the overhead expenses as outlined above takes care of practically all expenses incidental to this line of business. There may be two or three items which it may be deemed advisable to also include in the overhead, such as taxes, advertising, and bad accounts. The latter, particularly, should be such a small item with an electrical contracting business that it may be best to charge it to the profit and loss column. In some localities the item of advertising may call for very heavy expenditures. In such cases the total expense should be divided and the material and labor expenses be made to take the pro rata shares.

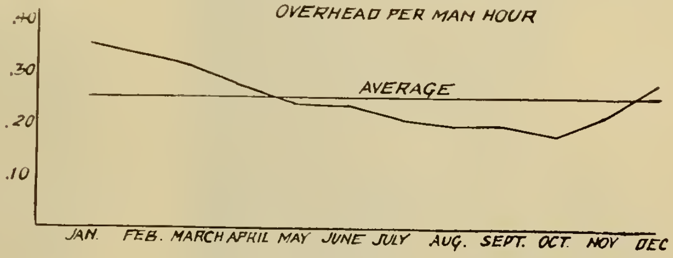


Fig. 2

Both the labor and material expenses may be readily shown graphically month by month. The writer finds it very convenient to plot these expense curves for reference. At a glance these will indicate the "pulse" of the business, for with an increase of business the overhead falls, and rises again with a slump in the business.

The curves in Figs. 1 and 2 illustrate graphically some of the expenses previously indicated. Fig. 1 shows some of the larger expenses. It may be desirable to combine the two expenses indicated by the general office salaries and clerks' salaries. In this particular instance, however, it was thought advisable to keep the clerks' salaries separate from those of the officers of the company and the engineer. Fig. 2 shows the overhead per man-hour curve and one drawn to indicate the general average for the entire year. One can at once see how the cost per man-hour decreases with the increase in the amount of business done. This, of course, bears out actual conditions when work is plentiful in the summer and fall months. With a decrease in business the overhead increases, due to the fact that the actual expenses are not proportional to the amount of exact business transacted. That is, if during the summer months the business increases 100 per cent. over that done during the winter, the expense of doing business will not fall in the same ratio. Actual facts bear out this statement since the expenses month by month for any particular business do not greatly vary.

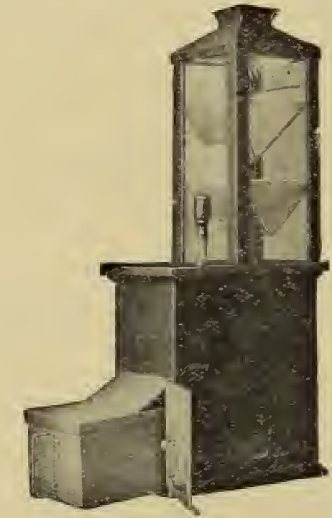
It is convenient, for record, to plot each expense month by month. At the end of the year a study of these will be of material assistance to any business in deciding upon policies to be pursued for the ensuing year."

A Practical Non-Registering Fare Box

The accompanying illustration shows an exterior view of a fare box that is manufactured by the Cleveland Fare Box Company, of Cleveland, Ohio. This box embodies an original style of locking mechanism combined with light yet durable construction. The cabinet, cash box and doors are of ⅛-in. cast aluminum and all working parts are of manganese bronze. It can be attached to the railing on the platform and can be arranged to operate either portable or stationary.

One of the construction features of the cabinet is found in the design of the corner posts which support the glass surrounding the inspection chamber. These corner posts are of cast aluminum with 3-16-in. cold rolled-steel tie rods, which hold the top casting to the lid of the fare box, applied on the inside of the corner-post angle. The tie rods screw into the top casting and are attached to the cover with jam nuts on the under side.

The inspection chamber has three saw-toothed baffles, so arranged as to make it impossible to remove cash or tickets. All fastenings are on the inside of the cabinet, making it impossible to take the box apart without destroying it or unlocking the cabinet door and removing the cash box. The spout and cabinet cover are cast in one piece and bolt to lugs on the inside of the cabinet, so that the whole construction is very strong and durable. The door of the cabinet is provided with a Yale or Corbin lock, and has a lug cast on the hinged side which prevents the door being removed even though the hinge pin should be taken out.


A practical fare-box

The cash box cannot be inserted in the cabinet until it has been unlocked, and it cannot be removed without locking itself. The bottom and sides of the cash box are cast in one piece and the top, to which the lid is attached, is rivetted to the upper portion of the box. The lid or door to the cash box has a special spring lock with a safety device attached, which makes it impossible to remove the cash box from the cabinet unless it is properly locked. This special lock is manufactured by both the Yale & Towne and the Corbin Lock Company, on specifications furnished by the Cleveland Fare Box Company, and no one can purchase this lock or a key to the same without permission from the fare box company. Guide grooves are cast in the sides of the cabinet for the support of the cash box, and lugs on the cover of the cash box must pass through ratchet wheels provided with dogs, which makes it impossible for the cash box lid to return in the same grooves it was inserted in.

This box was designed with the intention of keeping the key to the cash box in the counting room and the key to the cabinet in the hands of the car-house man who is delegated to remove the cash boxes from the cars. The cash boxes can be numbered and the number will be exposed through an opening in the cabinet, so the conductor can place the number of the cash box he is working on on his trip sheet the same as he does the number of the car.

The fares are placed in the box in the ordinary way by the passengers, the coin or tickets resting on the hopper door of the inspection chamber so the conductor can see that no mutilated or counterfeit coins or tickets are deposited. By means of a small lever the conductor controls the dropping of the fares into the cash box.

Exclusive Canadian Distributors

The firm of C. H. Basters & Company, who have offices and store rooms at 22 College street, Toronto, are exclusive Canadian distributors for an efficient line of Holland and German general electrical supplies, including the now well-known Condor lamp which has been on the market some 12 months and, according to reports, has given entire satisfaction. This business has grown very rapidly during the past year and the firm now have a number of travellers covering the Canadian field regularly.

In addition to the Condor lamp, which is their specialty, this firm have a varied display of electrical household supplies and novelties, including electric irons, water heaters, fans, stoves, fixtures, and the smaller kinds of fittings. Four types of iron are carried: a travellers' outfit, consuming 250 watts; a 6 lb. iron, 321 watts; an eight lb. iron, 400 watts; and a 10 lb. iron, 500 watts, the two latter being supplied with snap switch in the handle. Another interesting line is a bed warmer, to take the place of the hot water bottle, which consumes only 40 watts per hour. Among the other purely household equipments might be mentioned a Dutch brass teapot, quart size, consuming 500 watts; a 2 quart tea kettle consuming 500 watts and a saucepan with egg boiler attachment, 1 quart and 2 quart size consuming 380 and 500 watts.

Fans of various sizes are also carried, including an oscillating type specially worthy of notice in that the mechanism is all entirely enclosed within the motor frame. Another useful type is their adjustable fan which may be adjusted to any position and may be attached to the table, wall or ceiling.

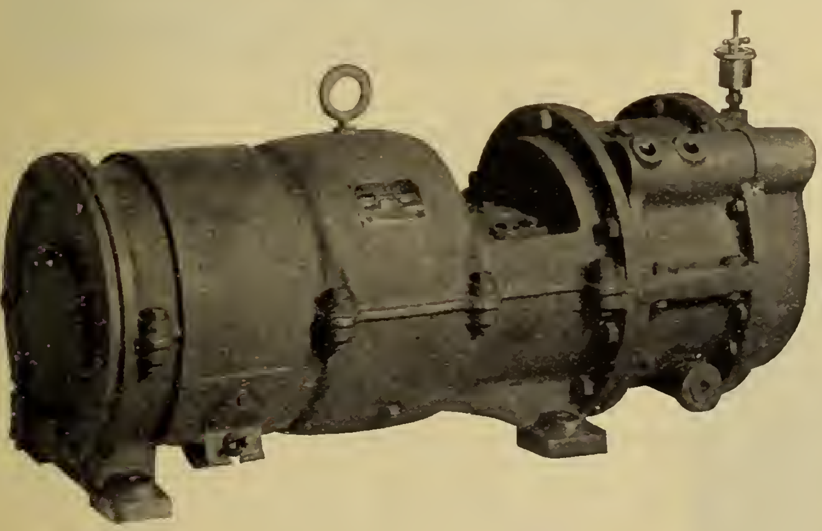
This firm's list of lighting fixtures includes a number of Dutch designs which are very handsome, especially one in carved Carrara marble. Their lighting fixture line includes a trouble lamp with patent switch in the handle and of waterproof construction; also numerous types of desk and portable lamps and a lamp replacer of very simple design and low cost for removing and replacing broken lamps. Electric stoves of the luminous type and also of the type using quartz tubes, will be carried in stock.

Decidedly the newest feature in this firm's equipment is their "reflector" lamp. Quite recently there was placed on the Canadian market a lamp with a self-contained reflector, the reflecting material being placed on the inside of the upper part of the lamp. The new reflecting lamp carried by the Basters Company differs in that the reflector is a separate part which fits over the base half of the lamp, the lamp and reflector being so carefully constructed that when assembled they appear as one unit. This lamp is protected by patents in Canada.

Among the novelties might be mentioned a flash lamp which combines a number of uses. This unit may be used as an instantaneous flash light or as a continuous source of light. It is also supplied with a 5 ft. cord at the end of which is a control switch enabling the lamp to be operated from a distance; this is an especially valuable feature for illuminating a clock or watch face in the night; the equipment includes a stand for the watch and also for the lamp so that these may be set in their proper relative positions on a table or chair near the bed and the cord placed with the switch end under the pillow or in some other convenient position. Another feature is the interchangeability of the push switch and the lamp unit so that the lamp may be placed on the end of the cord and the push switch attached to the battery and thus making a convenient "trouble" lamp. A fifth feature is its use in photographic work by covering the lamp with a small colored glass hood which fits on snugly.

A One-Kilowatt Turbo-Generator Lighting Unit

Light is frequently wanted for limited areas where steam is available but suitable electric power is not, as on contracting operations, small industrial plants, steam launches, etc. To provide a means for supplying electric light under such circumstances, the Westinghouse Electric & Mfg. Company have recently put on the market a small turbo-generator which will operate an arc lamp and a few incandescents at the same time, or about forty 25-watt mazda lamps, or their equivalent, alone. This unit is very compact, being only 3 feet long and 1½ feet high, and can be installed anywhere provided the unit is kept horizontal. It requires practically no attention when operating; there are no delicate adjustments to make; and all parts are easily accessible. The turbine and generator are mounted in the same frame. The turbine is of the impulse type and has a governor which keeps the speed uniform for all variations of load and steam pressure. The full rating of one kilowatt will be developed on 90 pounds steam pressure, and satisfactory operation can be obtained with pressures up to 250 pounds. The weight is 283 pounds. The rated voltage of the generator is 120 volts.



1 kw. steam turbo-generator

A New Vibrator

The Hamilton-Beach Manufacturing Company of Racine, Wis., through their Canadian agents R. E. T. Pringle are placing on the Canadian market a new type of electric vibrator to which they have given the name Try-New-Life. This equipment is manufactured in three types, two of which are illustrated herewith. The type shown in Fig. 1 is designed specially for home and family use. It is equipped with a 1/30 h.p. motor and is supplied with insulated cord and current tap for attaching to any electric light socket. Type B shown in Fig. 2 is identically the same machine as type A except that it is wound to operate on dry batteries instead of on the electric light current. This is meant for family use in homes where electric light is not available. Type C is a larger and stronger machine and is generally preferred by medical men. It is fitted with a 1/20 h.p. motor.

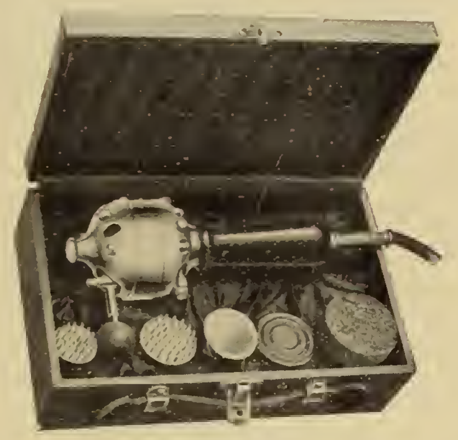


Fig. 1

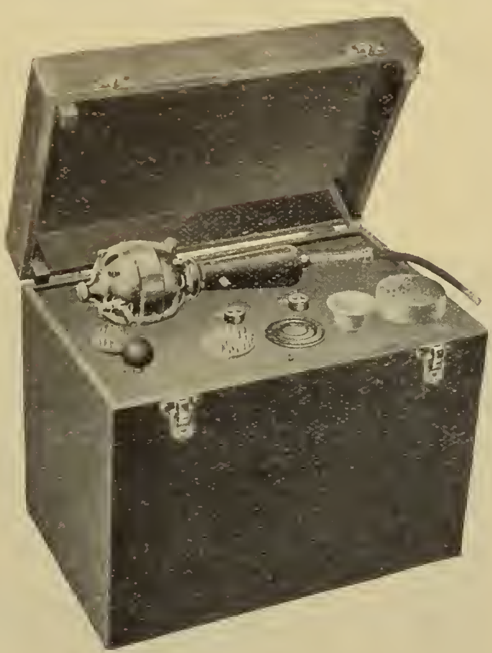


Fig. 2

The following rural telephone companies have been newly incorporated: Kindred Rural Telephone Company, Limited, Holdfast, Sask.; South Bethune Rural Telephone Company, Limited, Bethune, Sask.; Bethune South-West Rural Telephone Company, Limited, Bethune, Sask.; Sunnyside Rural Telephone Company, Limited, Normanton, Sask.; Grimes Rural Telephone Company, Limited, Lampman, Sask.; Duval & Dunkeld Rural Telephone Company, Limited,

Record Mine Operations

Eighteen 100,000 pounds capacity steel railroad cars, loaded in a single day, is the record output recently made by one motorman at Mine No. 1 of the Scalp Level Coal Mining Company, whose offices are at Windber, Pa. This mine is one of the John Lochrie operations and is situated in the famous Windber coal field. On this particular day they worked exactly nine hours and forty-five minutes. The only haulage equipment used was an eight-ton Baldwin-Westinghouse barsteel electric mine locomotive, equipped with commutating-pole motors. This locomotive, except for a few mine cars hauled from a dip from a point in the heading by a mule, did all the work, gathering the coal cars and hauling them to the tipple. The cost of operating this locomotive for the day was: motorman, $3.30 and spragger, $2.90, making in all $6.20.

Twelve mine cars, each loaded with two tons of coal. were hauled on each trip. The longest haul was made about 2,500 feet from the face of the first to tipple and about the same distance from face of main heading to tipple. The grades in this mine at the two points for a distance of 400 feet are 1½ per cent. against the loads. Thirty-six trips were hauled, and it is estimated that at least two minutes were lost on each trip on account of the motorman waiting for empty cars outside. Notwithstanding this loss of time the operators feel certain this was the highest run of coal ever made in Western Pennsylvania in one day by one motorman, and it is believed that it has never been equalled elsewhere.

Four-Ton Electric Dumping Truck

A new 4-ton electric dumping truck has just been placed on the market by The Baker Motor Vehicle Company of Cleveland. The dumping body is made of sheet steel reinforced with angle iron and is well riveted together. The floor is made of channel steel riveted together, with a smooth steel plate on top for floor. The tail gate is locked and unlocked by a lever at the side of the driver's seat. The body can be tipped to an angle of 45 degrees. The tipping is done by two arms, one on each side of the body, fastened to a large steel crank shaft which revolves in one direction only, two-thirds of the revolution to tip and one-third to lower. This allows the body to come down to its position on the chassis frame in half the time required to raise it for dumping. The body may be raised and lowered to its regular position in 50 seconds.

Electric dumping truck.

The dumping is done by either a hand crank or an auxiliary motor mounted under the seat and driving through a shaft and worm 8 spur gear reduction on the crankshaft. This shaft runs in oil contained in a dust-proof housing.

New Pole Line Hardware

Hubbard & Company announce the addition of a forged steel high tension pin to their line of pole line hardware. This pin was developed to overcome the inherent defects of the old types of malleable and cast iron supports for high tension insulators, and is claimed to be by far the lightest, strongest and cheapest pin of the center bolt separable thimble type on the market. The strength of all other separable thimble pins is limited to the bending strength of the centre bolt at the point of contact between the thimble and the main casting, and the diameter of this bolt is in turn limited to ¾-in. by the fact that the bolt must be small enough to screw into a cast thimble of not over 1⅛-in. outside diameter, in order to permit cementing into a 1⅜-in. pin hole. In the new forged steel pin the tapered collar of the thimble, which is of malleable iron, greatly reinforces the pin at its smallest diameter, thus allowing the use of the standard type of thimble without any reduction in the strength of the pin. When a stress is applied to a pin having a long center bolt, the bolt will stretch considerably, allowing a deflection, which in one case amounted to 5½-in. under a horizontal pull of 1750 lb., while a forged steel pin subjected to an equal stress deflected only ¼ in.

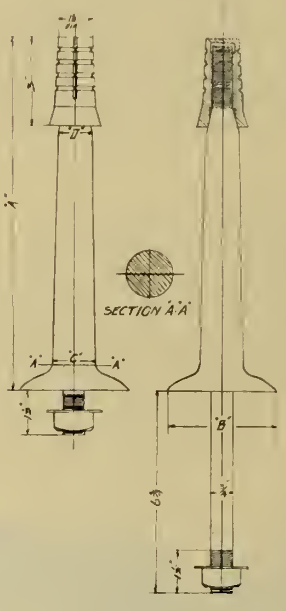


Fig. 1

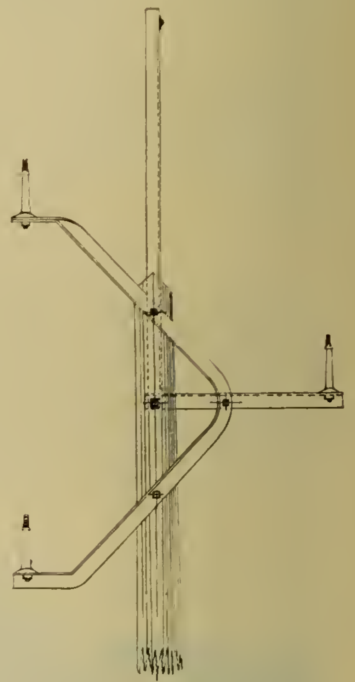


Fig. 2

The new forged steel pin is made in two styles, shown in Fig. 1, the long shank pin, for use with wood or channel steel arms, and a short shank type for use on arms of angle section, including the "Bo-Arrow" arm and high tension extension, Fig. 2. There are no welded joints in this pin, as it is forged from a solid bar of open hearth steel, insuring freedom from flaws. It can be furnished plain or galvanized to meet the N.E.L.A. test in different sizes. Its light weight, coupled with the fact that there is only one part to handle, will effect a marked saving in construction costs.

The malleable thimble used with the forged steel pin is also used with the high tension channel steel clamp pin for wooden and angle steel arms, and with the various types of pole top pins manufactured by this company. All of these pins, together with the Peirce cone type sheet steel pin, are described in the Hubbard Reference Book of Transmission

Line Construction, which is now ready for distribution, having been held up from time to time for the inclusion of new matter.

New 15-ton Electric Elevator

The Montreal Harbour Commissioners have just added another electric hoist to their equipment, making a total of three. The hoist is situated in the centre of a pier, with warehouses on either side, and is used for conveying freight and teams to and from the upper storeys of the sheds. It has a lifting capacity of 30,000 pounds, with a constant speed of 30 feet per minute under all conditions.

The hoist, supplied by Darling Bros., Limited, of Montreal, is constructed of a steel frame with diagonal bracings, covered with corrugated iron sheeting and a final covering of asbestos. The elevator platform is 30 feet long by 16 wide. On the ground floor level there is an opening to give access for the teams to the platform, and on the upper level a corresponding opening to allow teams to drive into the warehouses.

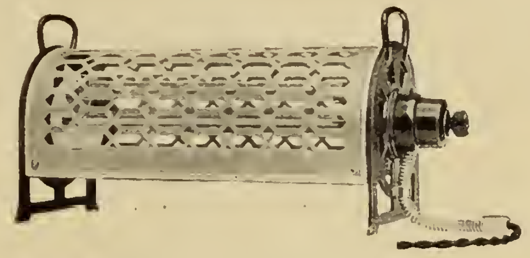
Another electric hoist for Montreal Harbour.

The electric current is supplied from No. 1 station and is a.c., 3-phase, 63 cycle, 550 volt. The motor is 52 h.p. of the C. G. E. slip-ring type. The resistance in the secondary circuit is automatically cut out as the motor starts, thus allowing the motor to develop a high starting torque with low consumption of starting current. The motor control mechanism is operated by an automatic a.c. reversing motor controller, which controls all operations of the motor and the elevator. All circuits to the motor are opened when the motor is stopped. There are no voltage and over-load release coils, this safety device preventing any accident should the power go off or the fuses fail at any period.

A New Type Luminous Heater

A new type of luminous electric heater has just been placed on the Canadian market which utilizes quartz tubes instead of glass globes as in other luminous radiators. This is called the Bastian heater and has been placed on the Canadian market by the Masco Company, Limited. The heating elements or glowers used in this heater are simply open-ended glowers with a spiral of nichrome alloy or other suitable heating wire extending through the tube, and terminating in a smooth plug at each end. Each quartz tube is therefore an independent glower unit which is fixed into the heater by means of a pair of spring clips. A unit is thus easily removed and replaced. In the smallest type of heater there are six of these tubes with 12 and 24 in the larger types.

Quartz possesses many advantages over glass in that it is not only transparent, but, it absorbs very little heat, allowing the heat to radiate through it with practically no loss. Quartz has a very high melting point and cannot be fused at normal temperatures. It has been maintained at a red heat in the atmosphere for a whole year without indicating any apparent chemical or physical change. It can even be plunged into ice-cold water when red hot without cracking the quartz, so that a spray of water falling on the heater by accident will not impair it in any way.



Quartz type Luminous heater.

It will thus be seen that this type of heater is very permanent in its character as the life of the quartz tube is practically unlimited and the wire spiral is all that would require to be replaced. Under normal conditions the wires are guaranteed by the makers for four years, and in this connection we are given to understand that the Westminster Electrical Testing Laboratories report that they have tested out a stock heater, type A, 250 watts, on an unregulated commercial circuit for 4,000 hours at the expiration of which time there had been no failures of any kind nor any sign of failures.

In ascertaining the requirements of the average room the manufacturers claim that 1 watt per cubic foot of space can be depended upon to raise the temperature 30 deg. Fahr.

Mainer Electric Company

Such a satisfactory statement of 1913 business was presented at the annual meeting of the Mainer Electric Company of Winnipeg, held on January 10, 1914, that the directors decided to immediately apply for power to raise the capitalization of the company to $500,000. This company has been in business eighteen months and during that time has succeeded in annexting a very generous share of the electrical supply trade in Western Canada. Plans for considerable increase in the scope of the company have been decided upon and very shortly two branch houses will be established. An auto truck delivery service will handle the city of Winnipeg business for the future. Mr. R. H. Mainer was again elected vice-president and general manager.

Announcement

Supplementary to the advertisement which appeared in the January 1 issue of the Electrical News the Swedish General Electric Limited, are distributing folders announcing that the business which has heretofore been carried on under the name of Kilmer, Pullen & Burnham, Limited, will in future be conducted under the name of the Swedish General Electric, Limited. The head office will be, as formerly, in the Kent Building, Toronto. Mr. Frank Pullen, the president of the company, states that this change of name has been adopted as conveying to the public a better idea of the business they are conducting, namely the supply of Swedish General Electric generators, motors and electrical installations of all kinds.

The receipts of the Nelson Street Railway System for 1913 were $13,857 as compared with $13,070 for the previous year. After February 1 the system will be operated by the municipality.

New Electric Firm in Ottawa

A new electric contracting firm, the Mac Electric Company, has started up in Ottawa, Ont., under the general managership of Mr. W. McInenly. The new company will carry a very complete line of all kinds of electrical apparatus and supplies. They will also specialize on electric elevators and at the present time are installing one in the Lavel building for Darling Bros. Co. It is said the new company maintain the largest repair shops in the city of Ottawa and are fully supplied with competent workmen in charge. Mr. McInenly is a nephew of Mr. T. Ahearn.

Two New Applications of Magnetic Separators

Removing iron particles from ground scrap rubber in the reclamation plant of a rubber mill and extracting the metallic iron from crushed slag in the steel plant are two new applications of Cutler-Hammer magnetic separators that have recently been made. The separating is effected on a belt over the magnetized pulley which picks out the metallic particles and allows the balance to be cast forward to a conveyor or chute.

Contracts have been awarded by the Kaministiquia Power Company in connection with extensions to their hydro-electric plant at Kakabeka Falls as follows:—850 feet of 11 ft. diameter steel penstock to the John Inglis Co.; one double runner 15,000 h.p. 257 r.p.m., twin spiral closed turbine and accessories to the Voith Company, and one 12,000 h.p., 3-phase, 4400 volt generator, together with all switchboard apparatus, cables and appurtenances, including five 1500 kv.a. transformers to the Canadian General Electric Company. Mr. R. S. Kelsch is consulting engineer for the company.

New Companies

Hilton Electric Company, Limited, capital $50,000, head office, Montreal.

A. B. See Electric Elevator Company of Canada, Limited, capital $100,000, head office Montreal.

The Ganges Water & Power Company, Limited, has been incorporated with head office at Ganges, B.C.

The Canadian Hot Point Electric Heating Company, Limited, has been incorporated with capital $100,000 and head office Toronto.

The Flour City Ornamental Iron Works, Limited, has been registered, with head office Vancouver, and capital $500,000. Among other products this company will manufacture ornamental lighting poles.

The Winnipeg River Power Company, Limited, have been incorporated. It is understood the object of this company is to develop power on the Winnipeg River which will be supplied to the Winnipeg Electric Railway Company.

The Stamp Falls Power Company have been incorporated. Among the objects of the company are stated to be the acquirement of the rights of the Ritchie Agnew Power Company and the interests of the British Columbia Hydraulic Power Company on the Nanaimo River and in the city of Nanaimo.

The Northern Electric and Manufacturing Company, Limited, of Montreal, has been re-incorporated with a capital of $10,000,000, under the name of the Northern Electric Company, Limited. The Standard Underground Cable of Canada, Limited, has increased its capital from $500,000 to $1,000,000, and the Kaministiquia Power Company, Limited, from $2,000,000 to $2,500,000.

Trade Publications

Wiring Devices—Bulletin No. 835, issued by Pass & Seymour, Incorporated, illustrating fully and describing, with prices, their handy electrical wiring devices.

"Standard" Fans—Catalogue No 10 issued by Robbins & Meyers of Springfield, Ohio, describing their various forms of ceiling desk, oscillating and exhaust fans for d.c. and a.c. circuits.

Mill Type Motors—Bulletin No. A4064 issued by the Power & Mining Department of the Canadian General Electric Company describing and illustrating fully this company's special motors for mill work.

Car Equipment—The Electric Service Supplies Company have issued a leaflet illustrating their F & P car replacer and St. Louis trolley pick-ups. Both of these are urged as being profitable equipment for every car.

Heating and Ventilation—Catalogue No. 215 issued by the D. F. Sturtevant Company, Boston, Mass. This is practically a treatise on the subjects of heating and ventilation being bound in book form and containing over 300 pages of useful information.

Lamp Guards—The Electric Service Supplies Company have issued an attractive folder describing and illustrating their Keystone Lamp Guards. An effective illustration shows clearly every detail in the construction of their portable type. A conduit box type is also shown and listed.

Block Signals—Bulletin 126, issued by the General Railway Signal Company, describing very completely their system of alternating current block signals as installed on the Southern Railway. The description is written by Mr. W. J. Eck, signal and electrical engineer of the Southern Railway Company, and explains and illustrates the system very fully.

Westinghouse Publications—The Westinghouse Electric & Mfg. Co. have issued the following booklets:—Motor Driven Refrigerating and Ice Making Machinery; Baldwin-Westinghouse Electric Mine Locomotives; and Westinghouse Portable Meters. These publications are splendidly illustrated and describe the various equipment very thoroughly.

Battery Truck Cranes—A descriptive booklet issued by the General Vehicle Company, Inc., Long Island City, New York, describing the G. V. battery truck crane. The booklet is well illustrated and gives some interesting facts on the variety of work this crane will perform, with cost figures. The same company have also issued No. 1 of Vol. 1 of the Central Station Bulletin which presumably will appear monthly in future.

Evershed's Instruments—A descriptive catalogue issued by Evershed & Vignoles, Limited, London, Eng., through their Canadian agent R. H. Nichols, Dineen Building, Toronto, describing the measuring instruments and other apparatus manufactured by this firm. The catalogue is very completely illustrated and descriptive including ammeters and voltmeters, leakage instruments, resistance testing sets, water testers, capacity meters, pyrometers, speed indicators, etc.

Automobile Lighting.—A little booklet issued by the Holtzer-Cabot Electric Company of Brookline, Mass., describing their magneto generator for automobile lighting and battery charging. This magneto has an output of 5½ amperes at 6½ volts and while not of sufficient capacity to supply all the electrical requirements of the largest cars is claimed to be large enough to meet the needs of the majority of cases. The booklet illustrates and fully describes the construction and operation of the system.

Current News and Notes

Arthur, Ont.

The Commercial Hotel have installed a small isolated electric generating plant driven by a gasoline engine.

Brantford, Ont.

The streets were illuminated in part on January 19 with the new magnetite arc lamps. It is expected that the complete system will be in operation by February 1.

The water commissioners have decided to close a contract with the Ontario Hydro-electric Commission for the supply of power to operate the waterworks pumps.

The local hydro-electric commission have decided to open a store for the demonstration, display and sale of electrical equipment, this store to be situated on one of the main business streets.

Brandon, Man.

Superintendent Antonisen of the municipal railway system will prepare and submit estimates of the cost of laying extensions to the street railway system.

Superintendent Antonisen has issued a report on the operations of the municipal electric railway system for the seven months of 1913 during which the line was operating. The report states that the average daily receipts were $143.84 and the average daily operating expenses $111.81. Operating expense does not include any sinking fund allowance, but for the short time the line has been in operation this may be considered a very satisfactory showing.

The 200 delegates of the Manitoba Growers' Association which met here on January 7 discussed among other things the hydro-electric power proposition. It appeared to be the general desire of the delegates to have the government do something in the way of establishing a distribution system along somewhat similar lines to that now in operation in Ontario.

Bellisle, P.Q.

The town of Bellisle, P.Q., are installing a system of electric lighting.

Chilliwack, B.C.

The town has entered into a ten-year contract with the B. C. E. R. Co. The company will install 100 candle power tungsten lamps on the streets and maintain them for $18 a year up to one o'clock a.m. each night and for $27 per year if an all night service is given.

Coaticook, Que.

The annual statement of the electric light department for the year 1913 shows a balance net profit of $1,611.

Creemore, Ont.

By-law has been passed by large majority for use of hydro power.

Calgary, Alta.

Tenders are called by the Department of Public Works, Ottawa, for three passenger and one freight elevator for the Calgary examining warehouse. Electrical equipment for these elevators is included in the tenders.

A report was recently published in the press that the city of Calgary was thinking seriously of developing one or more water powers in the neighborhood of that city, but we understand there is little likelihood of any movement in this direction under the present conditions. Before any large quantity of reliable power can be developed in that neighborhood a tremendous amount of money would be required to construct storage reservoirs in the mountains. The Bow River, for example, is very uneven in its flow, as is shown by the fact that the Calgary Power Company have a storage located at Banff which they use to advantage. The irregularity of the flow at the different seasons has been a determining factor in the recent action of the city of Calgary in building and maintaining a large steam plant to take care of the winter load. Until such time as money is available from the government or other source for the construction of a complete system of storage reservoirs it is therefore quite unlikely that this city will do anything towards developing any hydro-electric plant of their own.

Duncan, B.C.

It has been learned that the civic authorities of Duncan (Vancouver Island) have decided to delay the establishment of the proposed hydro-electric plant there for at least another year on account of the prevailing dullness in financial circles. An oil engine reserve plant of probably 200 kw. will be installed in the meantime, work in connection therewith being scheduled to commence without delay under the supervision of DuCane, Dutcher & Company, Vancouver, the consulting engineers for the city.

Embro, Ont.

It is probable a by-law will be submitted in this village in the near future regarding the installation of Niagara power.

Fort Frances, Ont.

At the recent annual meeting of the Board of Control of Fort Frances a large number of citizens were present from the International Falls, the town just across the river on the U. S. side, and discussed informally the prospect of recent electric power from Fort Frances to be developed at one or more points in the neighborhood of Fort Frances. It is understood the matter will be taken up with the Hydro-electric Power Commission of Ontario both as to the development of power and its export.

Fort William, Ont.

A report was recently made to the city council on the question of purchasing the entire system of the Mount McKay and Kakabeka Falls Railway Company to be operated as part of the municipal electric railway system. The city railway committee of Fort William will consider the matter.

The matter of connecting Fort William with Winnipeg by long distance telephone will be taken up with the Ontario and Winnipeg governments with a view to getting them to finance the scheme.

Guelph, Ont.

The Guelph Railway Company have awarded contract for two new cars to the Preston Car & Coach Company.

Hamilton, Ont.

A recent report on the laying of conduit in Hamilton showed that work to the extent of approximately $100,000 had been completed.

The Hamilton Street Railway Company have inaugurated a new rule by which their conductors are required to remain on the rear of their cars. It is said that since this rule has been in effect there has been a noticeable decrease in the number of accidents.

The Standard Underground Cable Company are considering factory improvements and extensions.

In connection with the new steam plant to be built by the Dominion Power & Transmission Company it is announced that contracts have been awarded to the Canadian Westinghouse Company for the initial electrical equipment;

Huntsville, Ont.

The newly elected council of Huntsville are taking up the question of further power development.

Harriston, Ont.

An all-night service will be given in this town in future, it having been decided that the extra cost is small in comparison with the advantages and conveniences to be derived from a more extended service.

Kelowna, B.C.

Active operations are planned for the coming spring or early summer in connection with the Belgo-Canadian Land Company's hydro-electric project at Mission Creek, 15 miles from Kelowna, in the Okanagan Valley. It is proposed to develop 2,000 h.p. at this point, and to transmit power into the city over the main transmission line at 13,000 volts. The company expects to dispose of its power to consumers in the adjoining district as well as in the city itself, the intention being to erect branch lines at different points along the main route. The final survey in connection with the project has been completed and plans were filed recently with the Belgo-Canadian Land Company by DuCane, Dutcher & Company, Vancouver, consulting engineers for the work.

Lake Megantic, Que.

New tenders to be called in a few weeks for the construction of the dam in connection with the municipal plant. First tenders were unsatisfactory.

Longueuil, P.Q.

The Armstrong Whitworth Company of Canada, who are building an extensive plant at Longueuil, P.Q., on the south shore of the St. Lawrence, propose to put in an installation for running the machinery by electricity and for lighting the works. The current will be supplied by the Montreal Light, Heat & Power Company at 22,500 volts, which will be transformed to 2200 volts. The equipment will include a synchronous motor connection up to a three-wire 500 volt, d.c. generator, and there will also be a large rolling mill motor. The current for lighting purposes will be transformed to 100 volts, flaming arc and tungsten lamps being used.

Lethbridge, Alta.

Tenders are received until February 9th for the installation in a public building, of an electric passenger elevator, to include the necessary electrical equipment.

London, Ont.

It is reported that the London Street Railway Company will purchase air brake equipment for a number of their cars.

The by-law which carried last year requiring the separation of the hydro-electric and the water department was repealed at the recent elections and these two departments will in future be under the same head.

Rapid increase in the demands on the electrical department will require an early extension of the transforming stations in London. This necessity has been emphasized by the recent contract with the London Street Railway which will eventually require approximately 1,000 h.p.

Markdale, Ont.

The Hydro-electric Power Commission have submitted a rate of $24.36 for power at this point when the Eugena Falls plant shall be completed.

Montreal, Que.

According to information given out at the City Hall, the engineers of Montreal are at work on a report recommending the immediate construction of subways as well as more surface tramway lines. Three subways are in contemplation, one running north and south, another east and west, and a third in the business section. Electric cars will be run in all three tubes, and provision will be made for connection between the tubes and the surface cars.

Through J. D. Lachapelle & Company, Montreal, the Canadian representatives of the C. & C. Electric Mfg. Co., three 75 h.p. complete automatic printing press equipments have been sold to the Star Publishing Company, Montreal, making a total of four equipments of the same size. A complete 400 amperes electric welding equipment with automatic switchboard has recently been sold to the Marine and Fisheries Department, Sorel, P.Q., by the same firm.

Tenders will be called for an electric steel sign for the Imperial Tobacco Company, 900 St. Antoine Street. Cost $8,000.

According to the annual statement of the Montreal Telegraph Company, the property is valued at $2,151,823, this being operated and maintained by the Great North Western Telegraph Company of Canada, its operation and maintenance being also guaranteed by the Western Union Telegraph Company. During the year quarterly dividends amounting to $160,000 have been paid at the rate of 8 per cent.

Contracts have been awarded to McDonald & Willson for the electric light fixtures required for the city hall annex.

The Wheeler Condenser & Engineering Company, of Cateret, N.J., has opened an office at 122 Board of Trade Building, Montreal, under the management of Mr. Jos. McKay, Jr., who has been for several years New York manager of the Wheeler company. The company makes a specialty of surface and jet steam condensers, forced and natural draft water cooling towers, feed water heaters, evaporating apparatus, and special castings for chemical industries.

At a meeting of the Montreal Electrical Society held on January 19, a resolution was passed emphasizing the importance of employing local professional men when expert engineering advice is required for civic purposes. The resolution continued: "We believe that in our city we have the necessary experts and ability to cope with any engineering problem which may present itself, and urge you, as our representatives, to recognize our own citizens in preference to the employment of outsiders." Messrs. P. T. Davies, T. H. Nicholson, and J. Towne were appointed to present the resolution to the Mayor and Controllers. At the same meeting Mr. Bradley T. McCormick, of Forbes and McCormick, Montreal, read a paper on "Induction Motors."

Mr. Tate, chief inspector of the electrical department of the Canadian Fire Underwriters' Association, Montreal, was among the Canadian representatives at the convention of Western Association of Electrical Inspectors, Cincinnati. Mr. Tate is a member of the Theatre & Show Wiring Committee.

A bill promoted by three shareholders of the Merchants' Light, Heat and Power Company has been before the Quebec Legislature. The measure asked that the directors should accept any reasonable offer that might be made to them in the interests of the shareholders for the exercise of the powers granted the company; that the company should not amalgamate with any other company having powers partly or wholly similar to those possessed by the company; and that the company should borrow three million dollars on bonds and debentures to be a first privilege on the moveable assets. The company is controlled by the Cedars Rapids Manufacturing & Power Company while the Montreal Light, Heat and Power Company are also largely interested. The legislature declined to alter the charter in the sense asked for by the promoters of the Bill, which was opposed by the directors, as contrary to the interests of the shareholders. Some minor clauses, however, were inserted.

Specifications of the proposed dam on the St. Maurice River, P.Q., have been prepared by the Running Waters Commission. The object is to provide an even flow of water for industrial purposes, and make possible the development of a very large amount of horse power. The dam is to be constructed above La Loutre Rapids, four miles above the mouth of the Wabane River, and will be 1,720 feet long.

Maisonneuve, P.Q.

The shipbuilding plant of Canadian Vickers, Limited, Maisonneuve, P.Q., will be driven by electrical motors, which are being constructed in England by Vickers, Limited. Current at 10,000 volts will be supplied by the Montreal Light, Heat & Power Company, and will be transformed by three large converters to a voltage suitable for the working of the machines and for lighting the plant. An hydraulic accumulator actuated by electrically-driven pumps to give a working pressure of 1,500 lbs. per square inch will also be installed, while in connection with the working of pneumatic tools, there will be two air compressors. A sub-station is now in course of erection.

Newcastle, N.B.

The wireless station of the Universal Radio Syndicate—the owners of the Poulsen system—is nearing completion at Newcastle, N.B. There will be six wooden towers, 300 feet high, and one of steel, 500 feet high, while the number of kilowatts utilized will be 300. The station on the other side is at Bally Union, County Kerry, Ireland. Mr. A. S. Baxendale, the managing director, states that before commencing business a number of experiments will be made in order to test the installation and some appliances which have just been invented.

Nanoose Bay, B.C.

The Giant Powder Company have announced that part of their powder works at Nanoose Bay, Vancouver Island, will be put into operation about the middle of February. The company recently installed a 500 kw. Curtis steam turbo-generator and the plant is motor driven throughout.

New Hazelton, B.C.

The Continental Development Company are installing a hydro-electric generating equipment of 200 h.p. at their Roche de Boule coal claims near New Hazelton, B.C. A motor driven air compressor will be used in conection with the plant, which it is expected will commence operations on March 1.

Niagara Falls, Ont.

Governor Glynn has announced his advocacy of a scheme whereby the present available water on the United States side at Niagara Falls should be taken over by their government and developed according to a general system very similar to that adopted in the province of Ontario. The amount at present available for this purpose is said to be 4,400 c.f.s.

Nickelton, Ont.

It is reported that the Canadian Nickel Corporation are preparing plans to generate their own electric power at this point. It is understood that the reduction works of this company will have an initial capacity of 40,000 tons per month. Nickelton is a recently incorporated town on the Eastern Algoma Railway, which will also be reached by the C. N. R. and C. P. R.

Ottawa, Ont.

The Ottawa Electric Light Company, we believe, are now leading in Canada in the matter of cheap rates for household purposes. Beginning January 1, this rate is 3½c. per 100 sq. ft. plus a meter charge of 2 1-5c. per kw.h. with 10 per cent. discount, the area being computed in the usual way. For commercial premises, hotels, etc., a rate of 5.33c. per kw.h. for the first 30 hours use of installed capacity with 2.22c. for all excess and 10 per cent. discount is given. Power rates are in proportion.

Mr. A. M. Beale of the Department of the Interior, Ottawa, has just made an investigation and is now preparing a report on a number of smaller water power sites in western Canada. His investigations were undertaken as the result of numerous applications that had been made to this department during the last few years for the right to develop water power on the smaller streams in connection with small municipal plants, factories, grist mills and even for general farm use. In view of the apparent wide spread interest in the development of smaller water powers for such local purposes and in view of the successful operation of small plants elsewhere it was decided to have Mr. Beale investigate the question fully.

Owen Sound, Ont.

In outlining his policy for the year 1914 the Mayor of Owen Sound expressed the hope that in the near future an improved system of lighting would be installed on the main streets.

Princeton, B.C.

The light and power equipment which is being installed on the outskirts of Princeton, B.C., for the Princeton Coal & Land Company, comprises only the first unit of an isolated plant which will ultimately be erected at this point, the present installation consisting of a 50 kw. Westinghouse generator driven by a Goldie & McCulloch high speed vertical engine. It is intended to utilize light and power in the operation of the company's mines, in addition to supplying the requirements of the town and adjacent district. The entire plant, including the distribution system, is being supplied and installed through Mather, Yuill & Company, consulting engineers, Vancouver, and will be in operation by the middle of February.

Port Stanley, Ont.

The hydro-electric department of Port Stanley shows a net balance of approximately $2,500 for the past year's operation. This does not include depreciation, which at 5 per cent. would amount to about $600, leaving a surplus of approximately $1,900.

Port Arthur, Ont.

During the month of December the combined earnings of the Fort William & Port Arthur Electric Railway Systems amounted to $24,961 of which the Port Arthur end earned $10,868 or about 44 per cent. and the Fort William end $14,092 or about 56 per cent.

Begining January 1, 1914, the Port Arthur rates for domestic and commercial lighting will be as follows:—Domestic—A service charge of 4c. per 100 sq. ft. plus a consumption charge of 2½ per kw.h. with 10 per cent. discount and a minimum charge of 25c. per month. Commercial—6c. per kw.h. for the first 30 hours use of installed capacity and 2½ per kw.h. for all additional consumption with 10 per cent. discount and a minimum charge of 50c. There is no charge for meter rental.

Paris, Ont.

Street lights were used for the first time in Paris, Ont., on January 8. 300 100-watt tungsten units have been installed.

Point Grey, B.C.

Messrs. DuCane, Dutcher & Company, consulting engineers, Vancouver, have prepared a preliminary report for the municipality of Point Grey, relative to the establishment of a municipal power plant and distribution system in that district at a cost of approximately $240,000, this expenditure to be spread over a two-year period. The report favors provision being made for a plant designed to act as a reserve and sub-station for hydro-electric power, and recommends accommodation for a Diesel oil engine and a steam turbine plant with oil fuel boilers, the oil engines to be utilized for lighter loads. The distribution system proposed provides for the erection of pole lines in the outlying parts of the municipality and an underground system in the Shaughnessy Heights district. It is understood that the recommendations of the engineers will be brought up for discussion at an early meeting of the Point Grey council—probably early in February.

Quebec, Que.

A contract has been awarded to the Steel Company of Canada for wire and other equipment in connection with the extension of fire alarm system.

Regina, Sask.

The operating returns of the Regina municipal railway system for the week ending January 3, 1914, are as follows: Revenue, $3,925.80; passengers carried, 92,638; passengers carried including transfers, 103,558. Corresponding figures for week ending January 10 are: Revenue, $3,911.80; passengers carried, 92,383; passengers carried including transfers, 102,576.

The new 1200 motor-converter has arrived and will be installed in the old power house. The present two, 400 kw. steam engine generator units will be maintained in future as a reserve. Satisfactory progress is being made on the new power plant near Lake Wascana where all power will eventually be generated, the old power house being used as a substation.

Rockwood, Man.

Permission has been given by the Rockwood council to the Winnipeg city light and power department to carry on a light and power business in the municipality of Rockwood. This municipality is already served by the Winnipeg Electric Railway Company.

Saskatoon, Sask.

A contract for the electrical work in connection with the government elevator has been let to a United States firm. There is considerable feeling among the local contractors as a result.

The municipal railway system of Saskatoon will use colored lights to indicate the route of the different cars.

St. Thomas, Ont.

The domestic lighting rate in St. Thomas beginning January 1, 1914, is 4c. per 100 sq. ft. plus a meter charge of 2½c. per kw.h. less 20 per cent. discount and a minimum monthly charge of 25c. The other rates are as follows: Commercial lighting—6c. per kw.h. for the first 3 hours' use of installed capacity and 2½c. per kw.h. for all additional consumption with 20 per cent. discount and a minimum charge of 50c. Power—A service charge of $1.00 per h.p. per month with a consumption charge of 2.5c., 1.7c., 0.2c. with 10 per cent. discount. Street lighting—$9 per 50 watt lamp, $10 per 75 watt lamp and $55 per arc per annum.

The operations of the municipal street railway system in St. Thomas, Ont., showed an approximate increase for the past year of $5,000 over the previous year.

Sydney, N.S.

It is reported that the Broughton Coal & Iron Company are considering the installation of an electric power plant, the power to be used in connection with the mining operations of the company.

The gross revenue of the Cape Breton Electric Company for the year 1913 was $374,883, an increase of $25,000 over the previous year. The net increase was $13,000.

Sherbrooke, Que.

The annual statement of the electric light and gas department for the city of Sherbrooke shows a balance on hand of over $15,000. This is after allowing liberally for maintenance and depreciation.

St. Marys, Ont.

The St. Marys, Kirkton & Exeter Telephone Company installed 62 telephones during 1913, making a total of 660 phones in service to date.

Strathroy, Ont.

A by-law will be submitted during February on the question of obtaining power from the Hydro-electric Power Commission of Ontario.

Spanish River, Ont.

The International Nickel Company are reported to be preparing plans for a new hydro-electric plant on the Spanish River which will double their present power and smelting capacity.

Stratford, Ont.

Considerable extensions to the electric lighting system will be made in the near future.

The electric department has shown a considerable surplus, in the neighborhood of $10,000 for the year 1913.

The electric business of Mr. Heideman has been purchased by Mr. E. Etherington, recently in the employ of the Stratford Mill Building Company, Mr. Etherington will carry a complete and modern stock of electrical fixtures and will also execute contracts for all kinds of electric wiring.

St. Catharines, Ont.

The Niagara, St. Catharines & Toronto Railway Company have purchased six interurban cars from the Preston Car & Coach Company. The body of these cars will be 56 ft., steel underframing, steam coach type of hood, and full empire interior finish. Three of the cars will be equipped with combination baggage and smoker. In the other three the baggage compartment will be eliminated. They will be equipped with multiple unit control for train operation, the intention being to operate the main line cars in trains of one or more units, according to the traffic. The equipment also includes Taylor trucks, electric markers, electric classification lamps, air sanders, etc. Weight of car completed will be about 65,000 lbs. and each will seat about 66 passengers.

The N. S. & T. Ry. Co. will install during the early summer a rotary converter set at Niagara-on-the-Lake consist-

SIEMENS BROS. DYNAMO WORKS | SIEMENS BROS. & CO.

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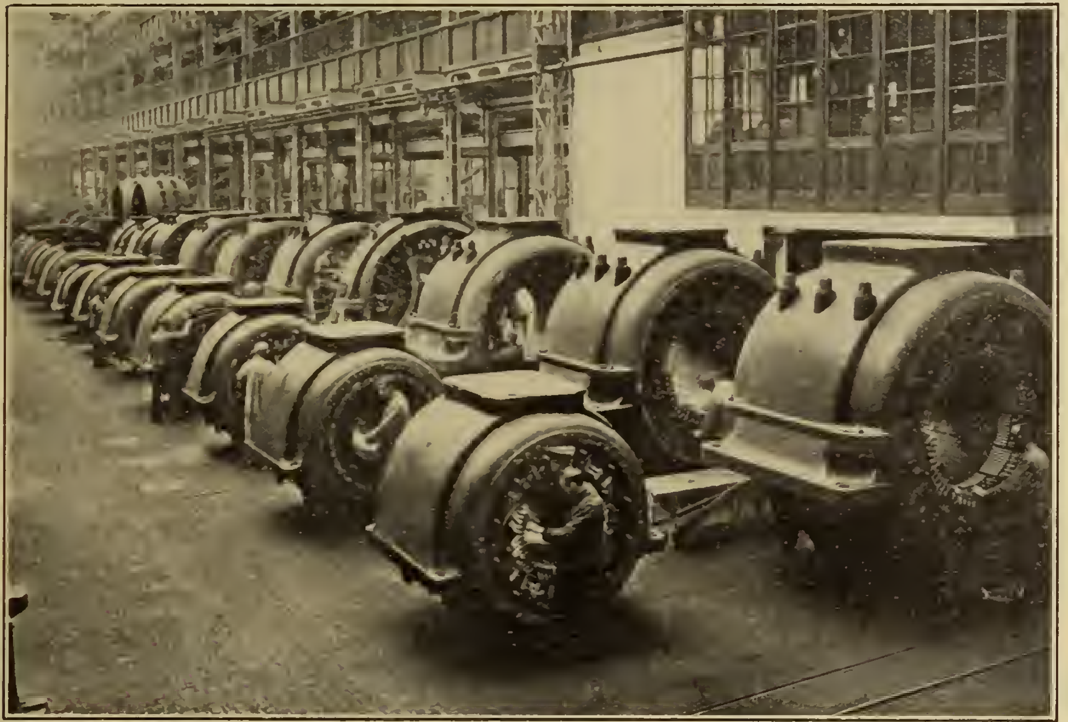


View in one of the Siemens Works showing Winding Department for Stators of Turbo Generator

The following Siemens **Turbo Generators** have been supplied or are on order for Canada.

1—4000 K.W. Edmonton.
1—3000 K.W. Regina.
1—2500 K.W. Dominion Coal Company.
1—2000 K.W. Dawson City.
1—2000 K.W. Dawson City.
1—2000 K.W. Dawson City.
1—2000 K.W. Edmonton.
1—1500 K.W Regina.
1—1500 K.W. Moose Jaw.
1—1500 K.W. Regina.
1—1200 K.W. Lethbridge.
1— 750 K.W. Nova Scotia Steel & Coal Company.
1— 675 K.W. Medicine Hat.
1— 675 K.W. Medicine Hat.
1— 500 K.W. Nova Scotia Coal & Steel Company.
1— 500 K.W. Nova Scotia Coal & Steel Company.
1— 500 K.W. Wayagamack Pulp & Paper Company.

The Siemens Companies manufacture Turbo Generators in single units of 30,000 H.P.

Siemens Company of Canada Limited

HEAD OFFICE:
Transportation Building - MONTREAL

BRANCH OFFICES:

STANDARD BANK BUILDING
TORONTO

McARTHUR BUILDING
WINNIPEG

ing of a 750 kw. Westinghouse unit, 375 volts on the a.c. side and 600 volts on the d.c. side. Power will be supplied by a 13,000 volt line which parallels the company's track from St. Catharines to Niagara-on-the-Lake where reducing transformers are installed. Power is supplied, of course, from the Toronto & Niagara Power Company's line. The building and machinery at this point will cost in the neighborhood of $25,000.

The company are also installing a new converter station at St. Catharines to be equipped with two C. G. E. 500 kw. converters and the necessary appliances. This station when completed will cost about $35,000.

St. John, N.B.

A conference was recently held between representatives of the St. John Street Railway Company and the municipal council at which terms were agreed upon for the extension of the railway line early in the summer from the present terminus through East St. John to Little River. This will open up a considerable residential section. It is said that the owners of new factories at Coldbrook, and others, have approached the railway company urging that the line be further extended to Coldbrook.

The Maritime Electric Company have been awarded a contract for the installation of the electrical equipment in the I. C. R. station at Moncton.

The Knox Electric Company have just completed the electric installation in a number of houses for the Fenton Land and Building Company.

The Stores Department of the St. John Railway Company will in future be known under the name of the Eastern Electric Company.

Mr. W. H. Dykeman has opened an electric store on Princess street, St. John.

The electrical contractors are endeavoring to form an association at St. John, N.B.

Toronto, Ont.

The Automatic Electric Cook Company suffered by fire to the extent of $20,000.

The management of the Grand Trunk Railway System will install a system of telephones in their Toronto terminals. It is understood that some 150 telephones will be required connecting Little York, Don, Mimico, Parkdale, Davenport and New Toronto.

R. C. Harris, Commissioner of Works, has been asked to report on a civic car line at the Beach to connect with Gerrard and Danforth; on the Lansdowne Avenue extension and on a belt line in Ward 7.

Two new double truck cars were recently placed on the lines of the Toronto Suburban Railway Company.

The Board of Control has decided to install an electric inspector for the city as required by the hydro-electric act passed some time ago by the Ontario legislature.

Truro, N.S.

Beginning January 1 the Chambers Electric Light & Power Company's contract with the town, for lighting the streets, expired. In future the streets will be lighted by the town plant and the Chambers Company will confine their attentions to the household and commercial supply.

The matter of rates to be charged by the Chambers Electric Light & Power Company in Truro recently came before the Public Utilities Commission of Nova Scotia. The rates decided upon were as follows:—15c. per kw.h. for the first 15 kw.h. use in any month; 12c. per kw.h. from 15 to 50 kw.h. each month; 9c. from 50 to 150 kw.h. each month; 8c. for all in excess of 150 kw.h. each month. All motors and heating appliances with a capacity not exceeding 1 kw.h. pay for current at the lighting rate as outlined above.

Power and heating rates for greater consumption were placed as follows:—12c. for the first 50 kw.h. per month; 9c. from 50 to 100; 8c. from 100 to 200; 7½c. from 200 to 500, and 7c. for all over 500.

Terrabonne, Que.

The plant of the Terrabonne Light, Heat & Power Company suffered by fire to the extent of $4,000.

Vernon, B.C.

A report of the electric light department of Vernon for the year 1913 shows the total number of kw.h. generated as 511,986 comparing with 335,646 in 1912. The maximum demand was 420, as compared with 266. After deducting expenses, 5 per cent. depreciation and interest on debentures, there is a net profit of $1,393.

Vancouver, B.C.

The Hinton Electric Company, Limited, have gone into voluntary liquidation.

Windsor, Ont.

It is expected that the new hydro line will be ready to deliver power in this city by April 1.

Winnipeg, Man.

The earnings of the Winnipeg Electric Railway Company on their city system for the past year were $2,584,597, an increase of $269,604 over 1912.

A contract has been awarded to the Canadian Motor Company for a 3½ ton Detroit electric truck for use by the electrical department of the municipality of Winnipeg.

A contract has been awarded to the Star Electric Company for 30 fire alarm boxes.

Tenders have been called for the placing of the tower footings on the new line to be built by the city of Winnipeg between the city and the generating plant at Point du Bois.

The financial statement of the Manitoba government telephones for the year ending November 30, 1913, shows a net surplus of $30,264. It is understood, however, that allowance has not been made for either depreciation or sinking fund for the retiring of the debentures as they come due. The amount mentioned as reasonable for the depreciation is $26,690 which leaves $3,574 to be set aside toward the sinking fund. As the total investment of the province in the telephone system is now over $10,000,000, neither the depreciation nor the much smaller amount for the sinking fund would appear to be at all adequate. It will be remembered that the telephone rates were recently increased, but even this does not appear to have been sufficient to provide for operating and other legitimate expenses.

Weston, Ont.

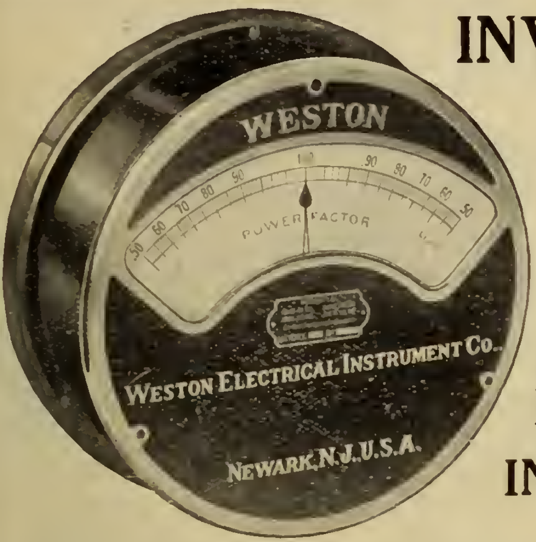
The electric light and water-works commission have decided to repair the old steam electric plant on Little avenue and maintain it as an auxiliary in case of a break-down in the hydro supply.

Walkerville, Ont.

Sub-contracts have been awarded for the construction of the Walkerville distribution station to the H. G. Christman Company, Hamilton; The Canadian Bridge Company, Walkerville, and R. Paddon & Company, plumbers, Windsor.

Yorkton, Sask.

A contract has been awarded to the Boving Company of Canada, Limited, for the supply of one 500 B.h.p. Diesel oil electric generator unit. Mr. M. M. Inglis is electrical engineer for the town.



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WESTON
A. C.
SWITCH-BOARD
INDICATING
INSTRUMENTS

We invite full inquiry into the merits of **Weston Power Factor Meters** and **Frequency Meters** and also **Wattmeters, Synchroscopes, Ammeters and Voltmeters** for Switchboard service on alternating current circuits.
Send for catalogs and advise us the kind of instruments in which you are interested, whether for alternating or direct current service.

Demonstrations of the operative characteristics of these remarkable instruments may be observed in our New York Office and also in the offices of Selling Representatives in Philadelphia, Chicago, San Francisco and Toronto.

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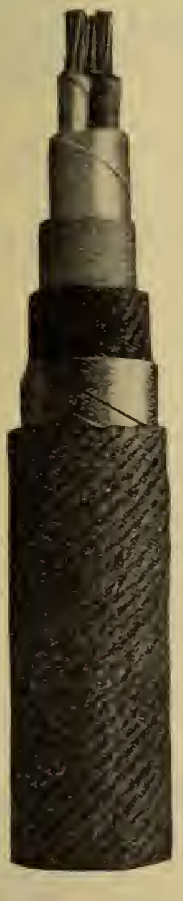
NEWARK, N. J.

New York, 114 Liberty St.
Chicago, 832 Monadnock Blk.
Boston, 176 Federal Street.
Philadelphia, 342 Mint Arcade.
Birmingham, American Trust Bldg.

St. Louis, 915 Olive Street.
Denver, 231 15th Street.
San Francisco, 682 Mission St.
Cleveland, 1729 E. 12th Street.
Detroit, 618 Union Trust Bldg.

Montreal, Winnipeg, Vancouver, Calgary } Northern Electric & Mfg. Co.
Toronto, 76 Bay Street.

London, Audrey House, Ely Place, Holborn.
Paris, 12 Rue St. George.
Berlin, Genest St. 5, Schoenberg
Johannesburg, So. Africa, F. Peabody Rice, Standard Bank Building, Harrison St.



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Manufactured by

British Insulated & Helsby Cables, Limited

PAID-UP CAPITAL, $8,500,000.00

HEAD OFFICE—PRESCOT, ENG. Works at PRESCOT, HELSBY and LIVERPOOL

Illustration shows a No. 10 B & S, 3 conductor, paper insulated lead covered and double steel tape armored cable for a working pressure of 660 volts. This cable is for laying direct in the ground without any protection whatever and is similar to that supplied to the cities of Saskatoon, Prince Albert, etc., etc.

WRITE FOR ILLUSTRATED CATALOGUE

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Canadian British Insulated Co. LIMITED

MONTREAL, QUE.

Condensed Department

Publisher's Notice.

Advertisements under "Situation Wanted" "Situation Vacant" or Miscellaneous, are charged at 2 cents a word per insertion, minimum charge 50 cents.

Advertisements for tenders, equipment, wanted or for sale, etc., are charged at $2.10 per inch.

All advertisements must be in the publisher's hands by the 10th or 23rd of the month to insure insertion in the subsequent issue.

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Bought, sold, rented, and exchanged. We have the largest stock in America. Send for our monthly bargain sheet showing complete stock with our prices.

GREGORY ELECTRIC CO.
CHICAGO, ILLINOIS
Established 1893

Wanted Employees

WANTED—Experienced man to take charge of meter testing in sub-stations and central stations. Salary $90 per month to start. Good chance for advancement.

Northern Ontario Light & Power Company,
24-1-2-3 Cobalt, Ont.

Wanted Employment

Partnership—Young man wishes an active partnership. Excellent mechanic, machinist and electrician, with good knowledge of gasoline and steam engines and pumps, also estimating and contracting work. Can invest some capital. Address Box 948, Electrical News, Toronto. 3-4

Electrical engineer, graduate B.A.Sc., 22, unmarried, with one year's experience, desires position with consulting engineer or manufacturing company where opportunities for advancement are good. Salary secondary. Box 952, Electrical News, Toronto. 3-4

Electrical and Mechanical Engineer, Associate A.I.E.E., desiring a change, wishes to correspond with parties in need of a good man. Is experienced in manufacturing, erecting, transmission, distribution, testing, operation and maintenance. Is at present electrical superintendent for large mining corporation. Address Box 944, Electrical News, Toronto. 3

Hydro-electric power house operator with considerable experience desires position operating or on construction work. References supplied if desired. Address Box 943, Electrical News, Toronto. 3

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HOT PROCESS
We use Prime Western Spelter and we Galvanize to Western Union standard specification.
QUEEN CITY GALVANIZING WORKS
5 Wabash Ave., off Sorauren Ave. N.
Toronto

CANADIAN OFFICE & SCHOOL FURNITURE CO. LIMITED
PRESTON ONT.
FINE BANK, OFFICE, COURT HOUSE & DRUG STORE FITTINGS.
OFFICE. SCHOOL. CHURCH & LODGE FURNITURE
SEND FOR CATALOGUE

Electrical Machinery

Motors, Dynamos, Generators,
Electrical Pumps and Supplies.
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Motor Repairs.

MAC ELECTRIC CO

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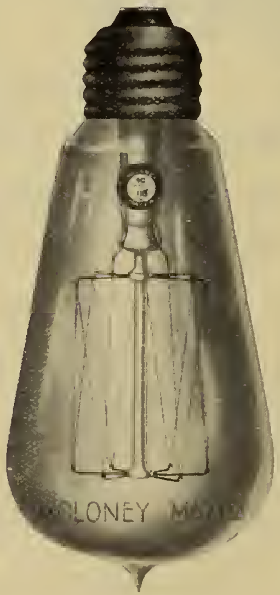
MOLONEY MAZDA LAMPS

Genuine Drawn Wire
Tungsten Filament

Burns at any Angle
Unexcelled in Quality

Rugged
Efficient
Durable



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Deliveries
from Stock

The
Mainer Electric Company, Limited
Winnipeg, Man. Edmonton, Alta.
The Largest Electrical Supply House in the West.

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CRANES AND CHAIN-BLOCKS,
GOOD GOODS AND SWIFT SHIPMENT.

THE HERBERT MORRIS CRANE & HOIST CO.
LIMITED.

EMPRESS WORKS,
PETER STREET,
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Tapes and Webbings
for
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Write for Samples and Prices

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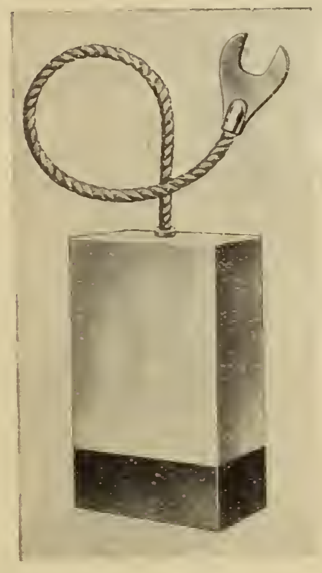

Special Motor and Dynamo Brushes To Order

We are prepared to make with accuracy and promptness any special sizes in carbon brushes.

Our B. B. special carbon brush is of the highest class. It is so blended and tempered that it has an extremely long life and the lubrication is positive through the life of the brush.

Get our catalogue containing prices.

Send us your inquiries for any style of Gauge – Carbon or Magneto Brushes

Becker Brothers
561 W. Washington St.
CHICAGO, ILLINOIS.

The home of
XCELADUCT
and
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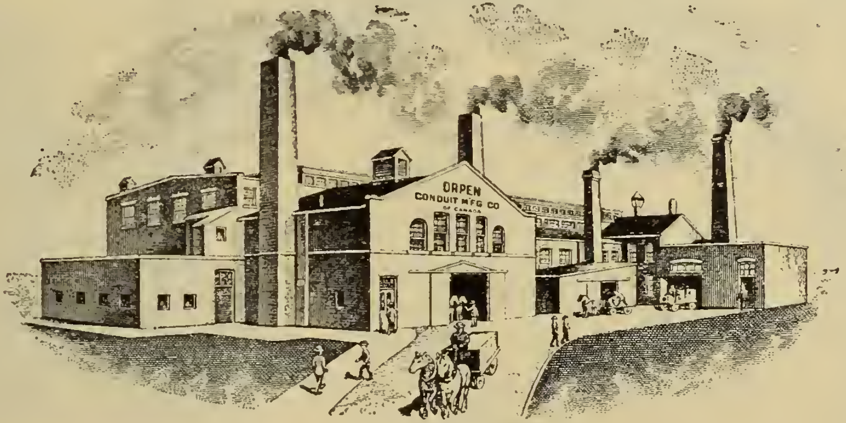
CONDUITS


ORPEN CONDUIT MFG CO OF CANADA

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and
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"XCELADUCT"

INTERIOR

"Xceladuct" is a high grade of galvanized conduit made of easy-bending spellarized steel tubing, doubly protected against rust by copper plating and zinc coating. Every length is made up with clean threads and smooth enameled interior, allowing easy and rapid fishing.

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XCELADUCT
AND
ORPENITE
CONDUITS

Let us send
Prices and Samples

"ORPENITE CONDUITS"

CONDUITS

"Orpenite" Enameled Conduit is made of easy-bending spellarized steel tubing which is protected against rust and proof against all temperature conditions by coatings of specially prepared enamel. Each length presents clean threads and a smooth interior permitting of easy and rapid fishing.

THE ORPEN CONDUIT MANUFACTURING COMPANY of CANADA
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Sole Canadian Distributors for

"CONDOR"

Lamps

Are you going to experience the same trouble this year in late shipments on your Electric Fan orders? You may if your order is not placed early. Why not get in touch with us now for this season's supply?

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BRITISH COLUMBIA.—Cope & Son Ltd. Water Street, Vancouver

ALBERTA.—General Supplies Ltd, 122 Eleventh Ave. W., Calgary

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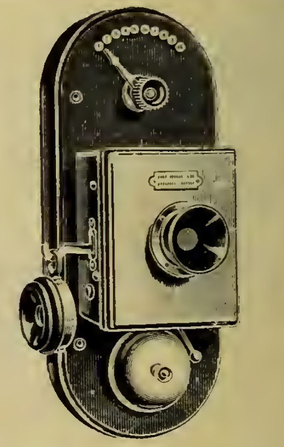
NOVA SCOTIA.—Stocks kept by:—John Starr, Son & Co. Ltd., Halifax.

NEW BRUNSWICK.—Stocks kept by:—St. John Railway, Dock Street.



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Reliable
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STERLING TELEPHONES
BRITISH MADE

Perfect Sodering

YOU know the worth of sodering flux that can always be depended upon for a perfect joint—any metal. That positively sure flux is ALLEN-Flux, non-acid, non-corrosive—made in Stix, Paste, Liquid, Presto-Soder, also

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in pulverized form—add water and make a perfect liquid flux—better and cheaper to use than muriatic acid or anything else. Absolutely non-poisonous. We want you to try it. Send your dealer's name and 15c. for liberal sample. Your money back if not satisfied.

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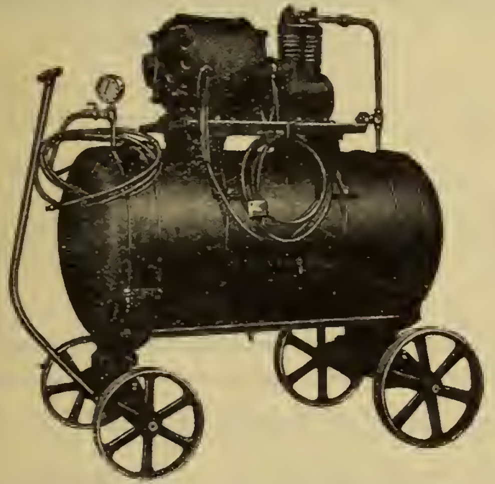
Century Single Phase Motors are especially valuable for the



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operation of portable air compressors because they all have interchangeable voltage connections (Standard 104-208 volts.)

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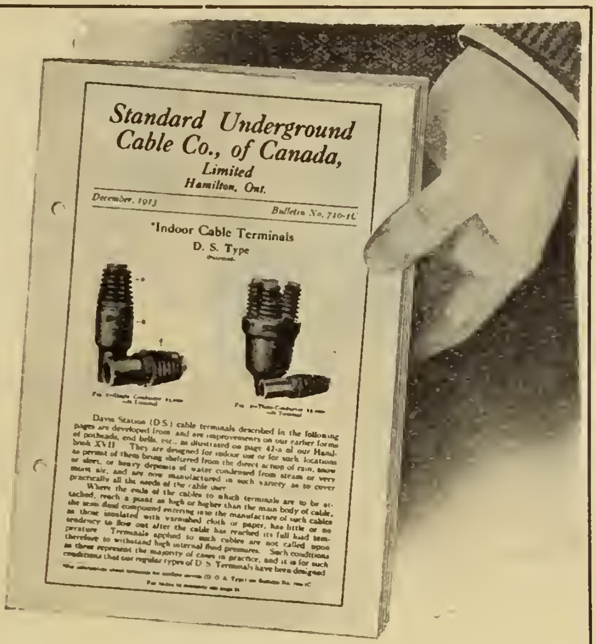


Standard Underground Cable Co., of Canada,
Limited
Hamilton, Ont.

December, 1913 Bulletin No. 710-1C

*Indoor Cable Terminals
D. S. Type

Let Us Send You This New Bulletin!

It is filled with valuable information for the buyer and user of cable terminals. There are tables of dimensions, weights, voltages, etc., that should be in your files.

The useful character of this book will be apparent after reading the following:

Table of Contents

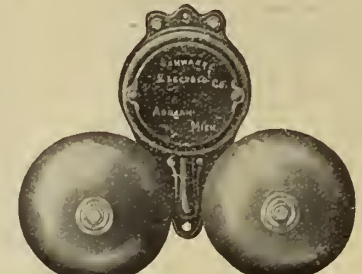
- General Description of D.S. Terminals.
- Regular Types of D.S. Terminals.
- Inner Seal Terminals.
- Wiped Joints vs. Clamped Joints.
- Separation and Insulation of Conductors.
- Insulating Compounds.
- Terminals for Ordinary Service.
  - Single Conductor Terminals.
  - Multi-Conductor Terminals.
- Terminals for Special Service.
  - Pipe Top Terminals.
  - Switchboard Terminals.
  - Inner-Seal Terminals.
  - "Elbow" Type Terminals.
  - "Horizontal" Type Terminals.
  - Terminals for Armored Cables.
  - Terminals for Concentric Cables.
  - Panama Terminals.
- Brackets.
- Tests.
- Instructions for Ordering.
- Instructions for Installing.

Write to our nearest office NOW for your copy of this bulletin. A card will bring it.

Standard Underground Cable Co. of Canada, Limited
Hamilton, Ont.

Montreal, Que. Winnipeg, Man.
Boston, Mass. Seattle, Wash.

Manufacturers of Electric Wires and Cables of al kinds, all sizes, for all services, also Cable Accessories.



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There can be only one best and that is the Schwarze. No. 12 Common Magneto Extension for telephone Service is illustrated herewith. The spools are large enough so that in no case is it necessary to use over No. 35 magnet wire, thereby obtaining the maximum number of ampere turns, and this wire is all active. Armature is under influence of coils its entire length. Poles arranged so that permanent magnet cannot be discharged, and will not weaken.

No. 13, same as No. 12, except larger and very much louder, and is for signalling purposes on high tension 60 cycle. Fully approved by Underwriters.

All weatherproof. Write for catalogue. All resistances.

Schwarze Electric Co., Adrian, Michigan

Norton Telephone Co., Canadian Agents

Booth

Saves time and money for anyone wanting Felt Washers, Packings, Gaskets, or mechanical felt goods of any description.
All sizes made in Canada and shipped within 24 hours.
Send us your orders.
Try Booth out on a basis of quality, time and cost.

If it's made of felt, ask Booth

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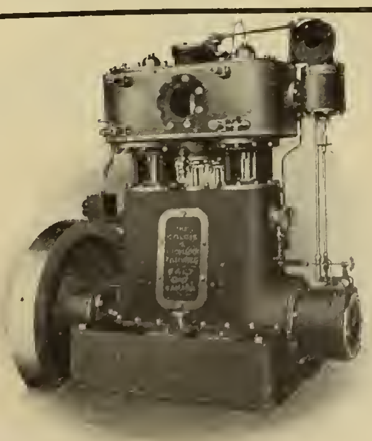
Long Lengths 7 ft. Thick Walls 3/8 inch. Long Joints 5/8 inch

We will absolutely guarantee a puncture strength of 50,000 volts and an absorption of moisture for 100 hours of less than 3/4 of 1%.
Comparison of above figures with other types of Fiber Conduit will show the superiority of our product.

American Conduit Co.

East Chicago, Ind., U. S. A. 140 Nassau St., N. Y. City

Distributors for Canada:
The Northern Electric & Mfg. Company, Limited, Montreal, Halifax, Toronto, Winnipeg, Regina, Calgary, Edmonton, Vancouver.



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Quick Revolution Engines

With Combined Throttle and Expansion Governor

These engines are giving excellent service wherever installed. They are built for service and are economical in consumption of steam and require little or no attention while running. The materials used are in accordance with British Admiralty Specifications. Ask for detailed information.

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Branches:—Toronto Montreal Winnipeg Vancouver and St. John, N. B.

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Pole Line Material

We can furnish any quality of arms, pins, brackets, or pole line hardware you call for if you can wait for factory shipment, but stock only which carries our guarantee.

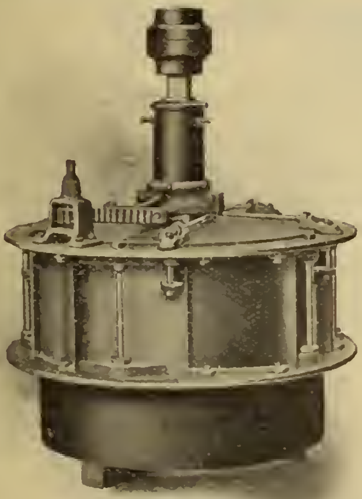
Superior

This includes: Washington Fir not less than 85% heart, Georgia Pine—Long Leaf—not less than 75% heart Kyanized—Spruce. Pins and Line Hardware—A T and T specifications.

STUART-HOWLAND COMPANY

131 to 141 Federal St., - BOSTON

The "Canadian" Turbine Water Wheel



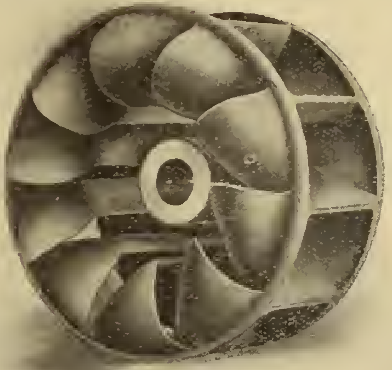
THE CANADIAN TURBINE WATER WHEEL CONSERVE THE WATER POWERS TRADE MARK.

REGISTERED

A normal speed Turbine of normal capacity. Not overgated or overrated. Steady, sturdy power from quarter to full gate.

Efficiency, Durability and Genuine Satisfaction assured.

Write for Catalogue No. 12.

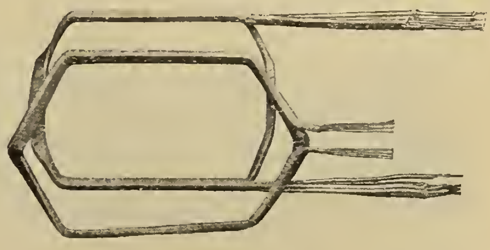


CHAS. BARBER & SONS, Meaford, Ontario

Established 1867

A SPECIALIZED SERVICE

In taking over the complete electrical department of the Van Dorn & Dutton Company, including skilled workmen and tools—supplying additional facilities—and specializing in such work alone, we are enabled to render an invaluable service to electric railways, in supplying Armature, Field and Induction Motor Coils or Commutators, in Armature or Solenoid rewinding and general repair work. We are prepared to make quick deliveries on high class work at the right prices. Write for the details of our service.



Cleveland Coil & Manufacturing Company

(Successor to Van Dorn & Dutton's Electrical Department)

R. P. Pascoe, Manager. 1011 Power Avenue, N. E., CLEVELAND, OHIO

Cedar

We are now handling both Western Red Cedar and Northern White Cedar Poles. Write for prices. Quick shipments.

Crawford Cedar Co.
Menominee, Mich.

Poles

Our
British Columbia Cedar Poles

will meet your most exacting requirements. You'll find them straight, strong, sound-butted, and shipped on time. Let us quote you.

The Lindsley Brothers Company
"Good Poles Quick"
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That Stands the Test of Time and Weather

We make all articles required

WIRES

Copper—Galvanized

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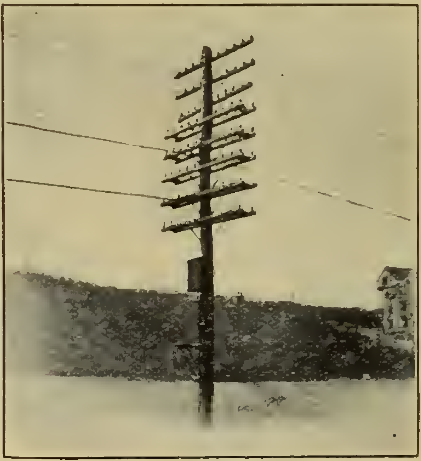

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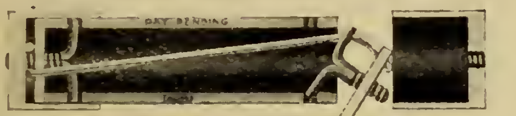

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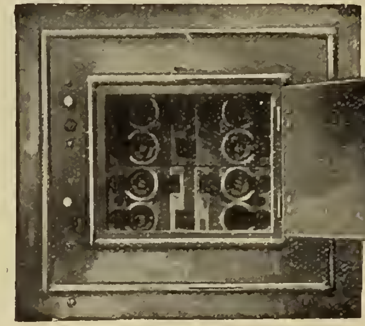

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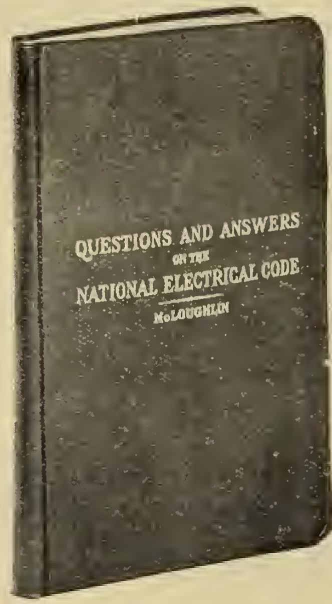

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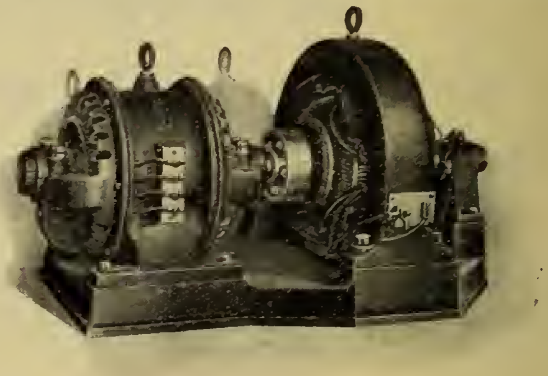

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Electric Circuit Theory and Calculations by W. Perren Maycock, M. I. E. E., published by Whittaker & Co., 1913, (Just out), Price $1.00.

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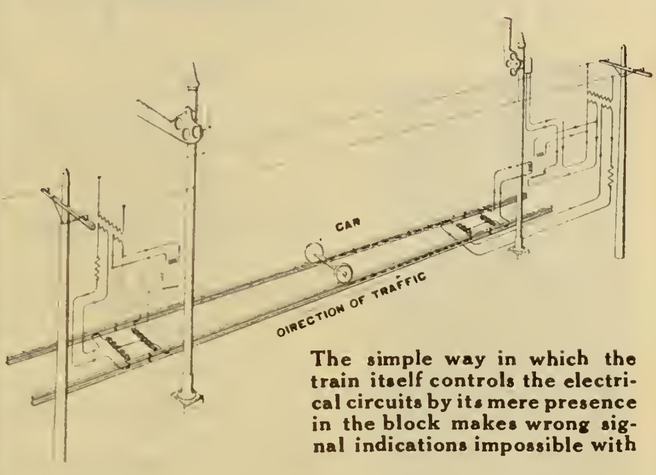

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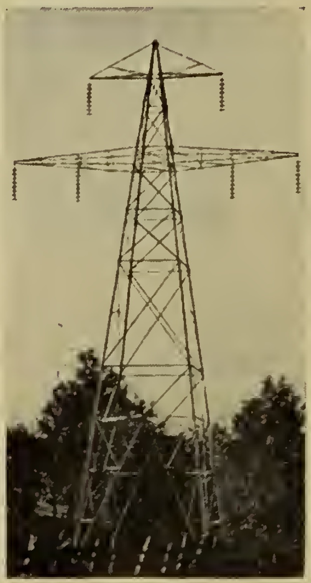

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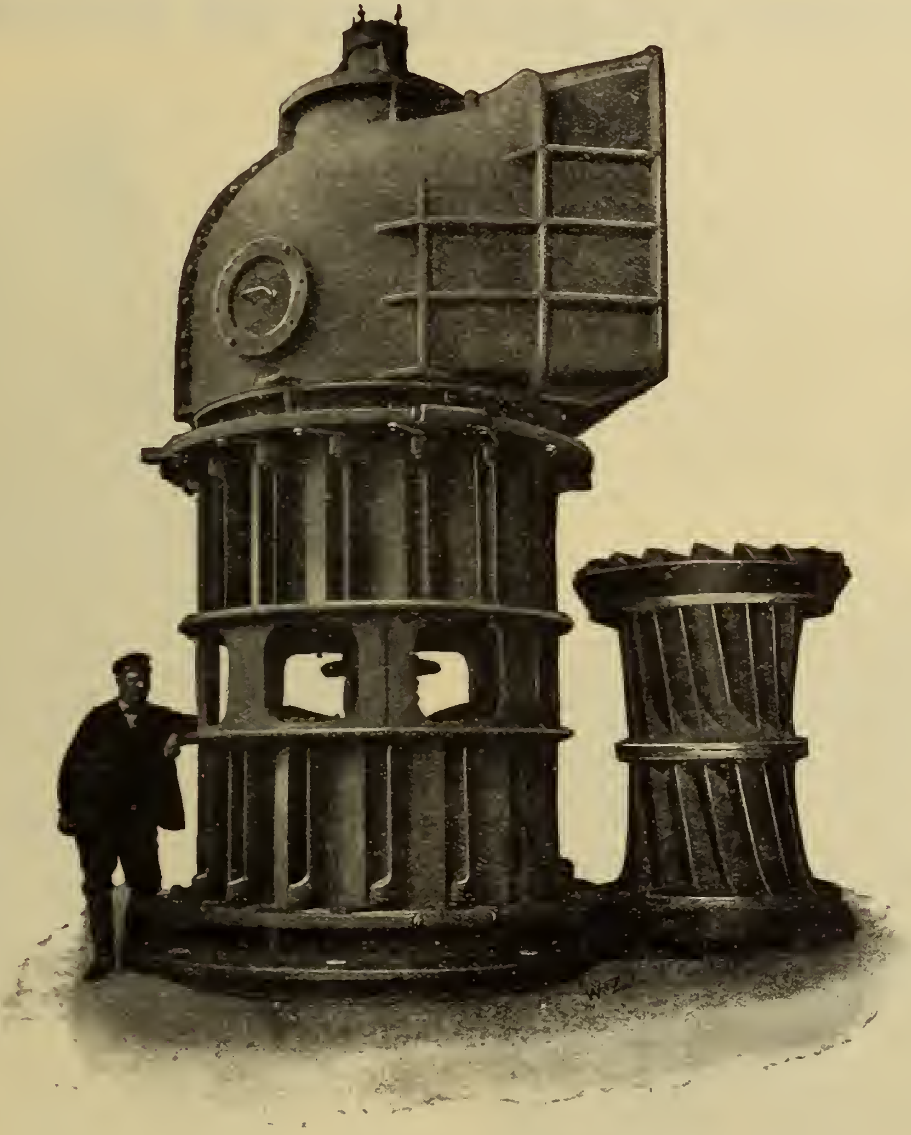

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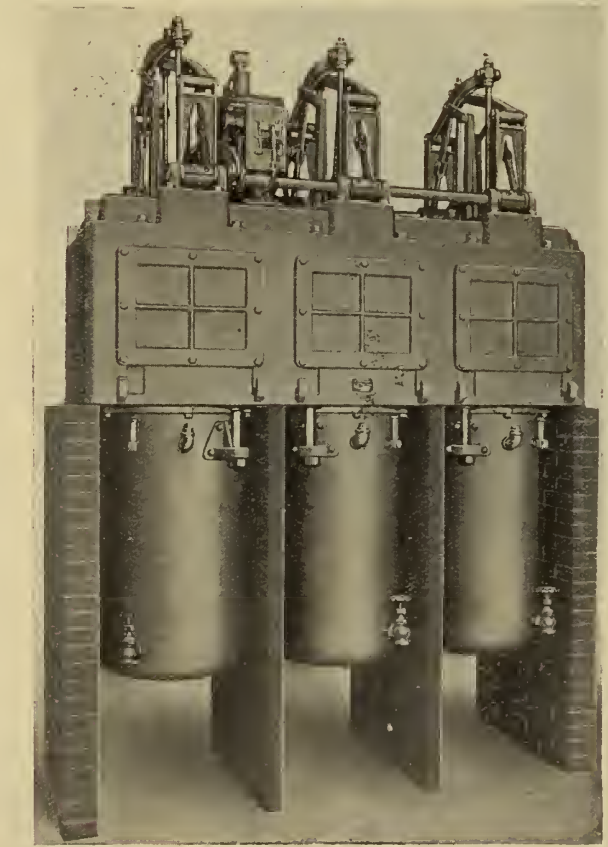

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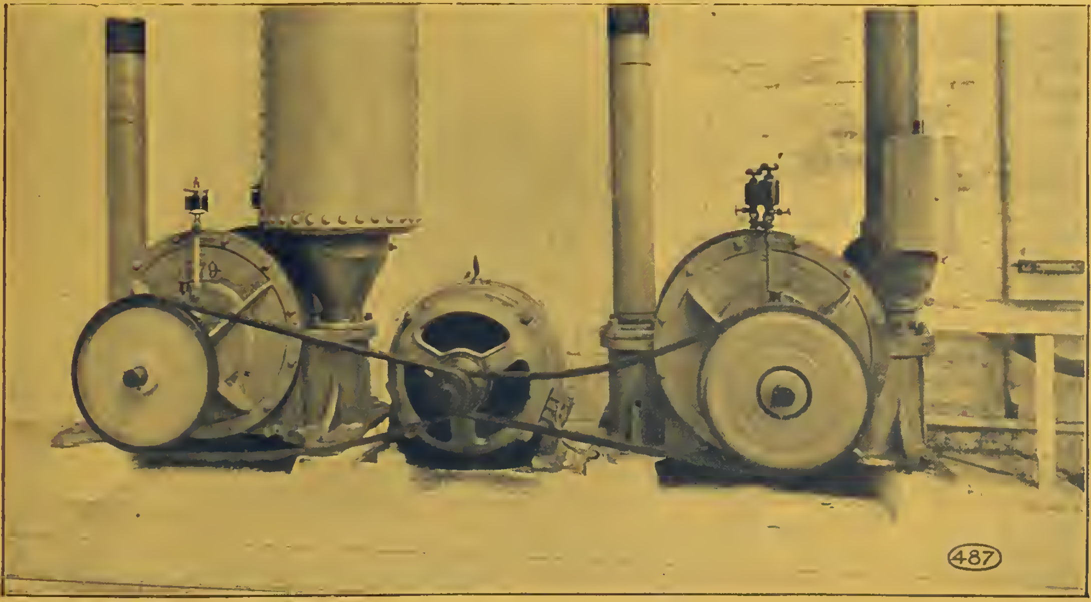

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Fred. Thomson Co., Limited

326-328-330 Craig Street West
Montreal

For the Good of Your Service

specify the well-known G & W Line of Distribution Specialties. They reduce the time of service interruptions to a minimum. The line includes POT HEADS—detachable and non-detachable, SUBWAY JUNCTION BOXES, SERIES SWITCHES, PRIMARY CUT-OUTS, GROUND-PIPE CAPS, VOLTAGE DETECTORS, FUSES, COMPOUND, etc. Send for Catalog.

G&W
ELECTRIC
SPECIALTIES

G & W ELECTRIC SPECIALTY COMPANY

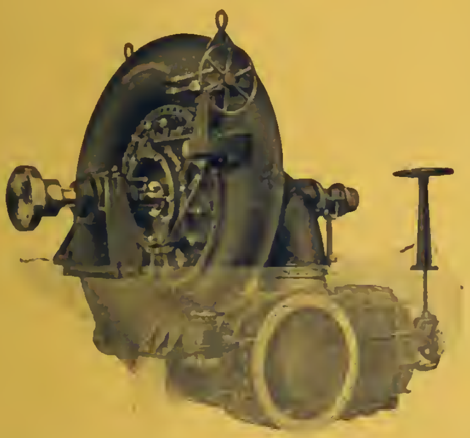
6306-10 Blackstone Avenue - - - CHICAGO, U. S. A.

24

Vol. XXIII No. 4 Toronto, February 15, 1914

Electrical News

Generation, Transmission and Application of Electricity



90% EFFICIENCY

From SMITH HYDRAULIC TURBINES

Recent tests at Holyoke, Mass. on Standard Smith Turbines have again proven their superiority over any turbine now manufactured.

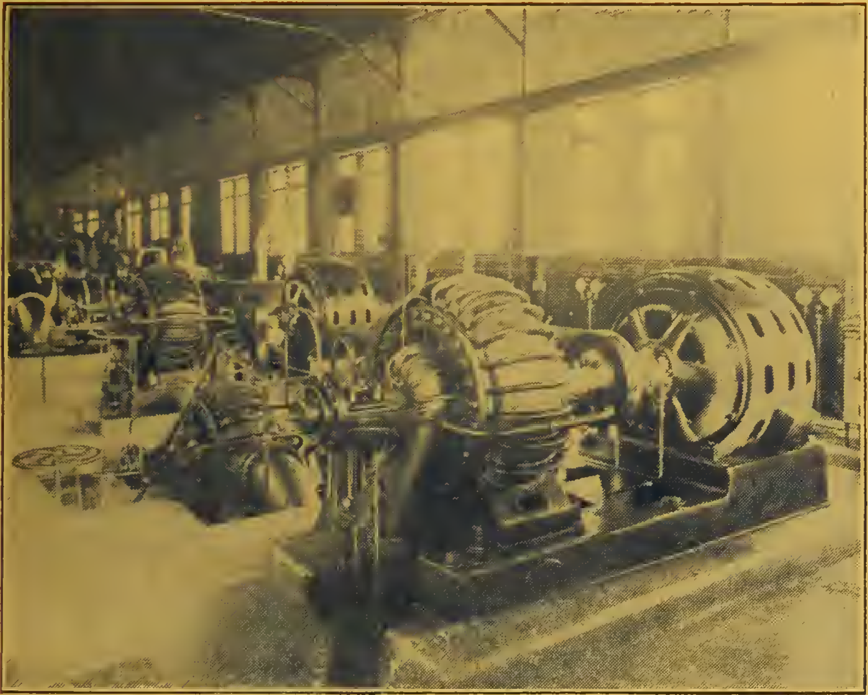
These tests showing efficiencies from **89% to over 90%.**

We design and build turbines for heads from 5 feet to 650 feet. Engraving represents a turbine of 900 H.P., 250 R.P.M., 110 feet head.

Send for Bulletin N

S. Morgan Smith Co., York, Pa.

Branch Offices: 176 Federal St., BOSTON, MASS.
614 American Trust Bldg., CHICAGO



Three 10,000,000 Gallon Pumps against 200 lbs. pressure supplied to the Montreal Power & Water Co.

High Efficiency Water-works Pumps

One of the pumps shown in the picture was installed by us two years ago and we have since installed the other two shown in the same picture.

*Repeat Orders
Speak For
Themselves*

BOVING & CO. OF CANADA, LIMITED

TORONTO VANCOUVER *Works* LINDSAY, ONT.

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PHILLIPS

Electrical Wires and Cables

Bare and Insulated Copper Wires and Cables.

Bare and Insulated Electric Wire and Cables for Aerial and Underground Use.

Railway Feeder and Trolley Wire.

Weatherproof Magnet and Rubber Covered Wires and Cables.

Incandescent and Flexible Cords.

Telephone, Telegraph, Lighting, Power and Street Railway Wires, Cables and Equipment.

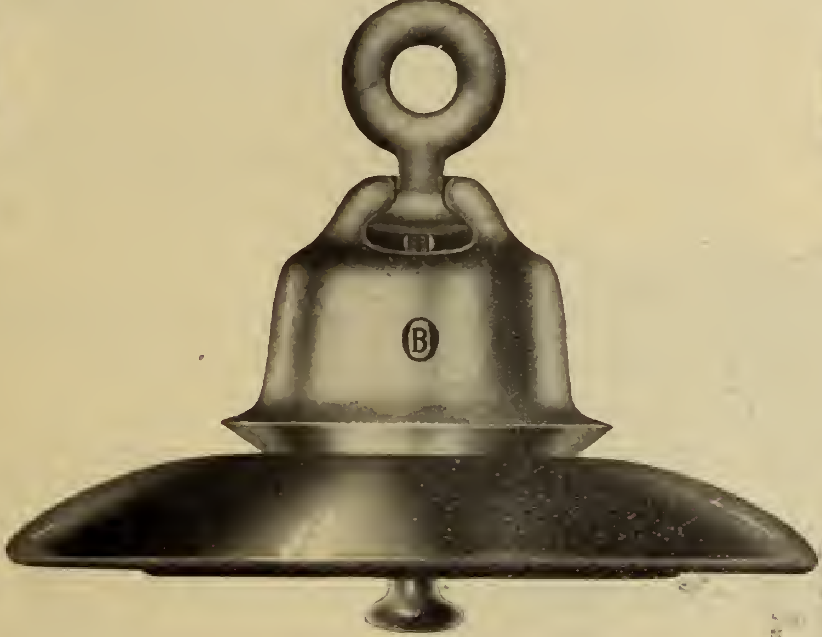
Eugene F. Phillips Electrical Works, Limited

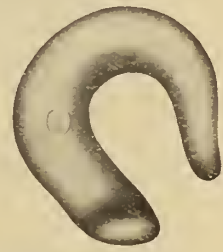
MONTREAL - - CANADA

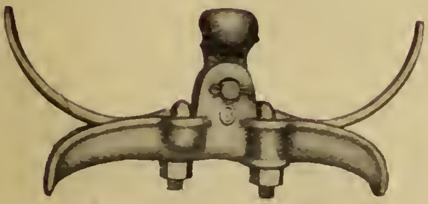
Branches: HALIFAX TORONTO WINNIPEG VANCOUVER

O-B Suspension Insulators and Hardware

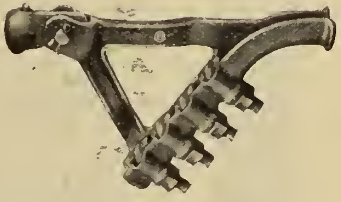
Suspension Eye


Type B Suspension Unit


Suspension Hook


Type B Suspension Clamp

Type A Clamp


Type E Strain Clamp

Give reliable service as a direct result of our watchword, "Quality First." Quality is the first consideration in design and in all processes of manufacture.

O-B Insulators have been adopted on many of the most important transmission lines in America after thorough investigation and severe tests. The Hydro-Electric Power Commission of Ontario and The Mississippi Power Development at Keokuk are two of many projects where O-B Insulators are proving that our watchword pays.

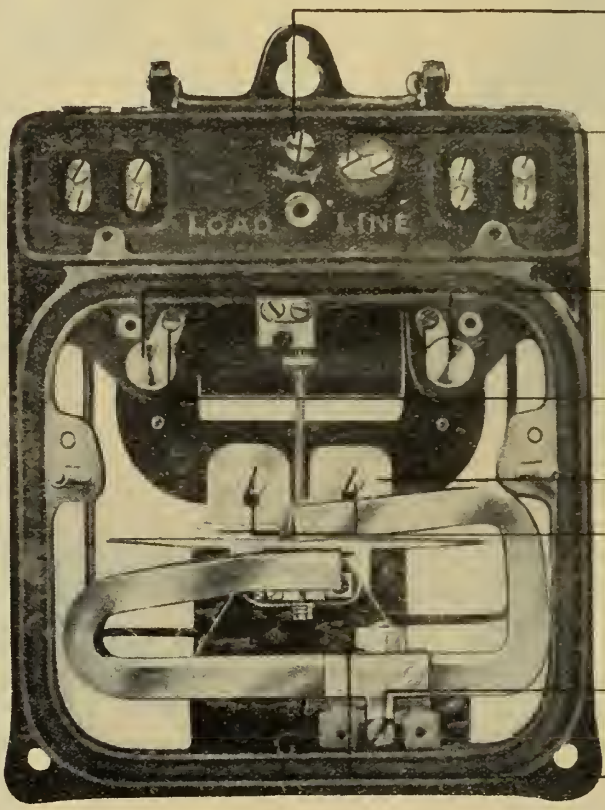
The Ohio Brass Company

Mansfield - - Ohio, U. S. A.

FERRANTI

Can you beat this for easy accessiblity to All Adjustments?

A peep at the inside of our Type "C" meter (Front View)



Clamping Disc – Turn in direction of arrow to unclamp the disc.

Testing. – For testing a number of Meters in series, disconnect link and connect potential lead here.

Low Load Adjustment.—Turn the Left hand Screw IN or the Right-hand Screw OUT to speed up on low load.

Tighten here to lock Adjustment.

Inductive Load Adjustment. Raise the Copper Lagging Coil to increase the speed on Inductive load.

Tighten here to fix coil.

Full Load Adjustment. – Screw Magnet inwards here to speed up

Tighten here to lock Adjustment

POINTS WORTHY OF NOTE:

Each part is removable independent of the other.
Low load adjustment—this system insures a much closer adjustment than can be obtained in any other meter.
Magnet or Full Load adjustment—note the rigidity of this arrangement preventing any possibility for a change in its position.
Spring seated saphire jewels (protected against damage in handling of meter by clamping-disc) are used. All friction is eliminated by use of lining adjustment for top bearing.
Send in a trial order and realize the advantages of these points for yourself.

EVERYTHING IN METERS

FERRANTI ELECTRICAL COMPANY OF CANADA LIMITED

90 Sherbourne St.
TORONTO

Farmer's Advocate Bldg.
WINNIPEG

I CIRCUIT T BREAKER E

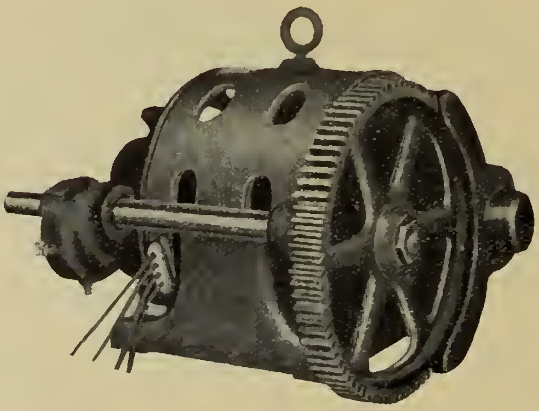
We do not get in on these big railway installations at first. In these ten million dollar propositions the circuit breaker is a mere detail, it goes in with the rest of the equipment for a lump sum, but notice what happens. As these stock circuit breakers begin to give out, as they will, and the Operating Engineer begins to observe their faulty operation, as he does, what happens? They are gradually replaced and invariably with I-T-E.

Make a note of the fact that no job is too big for us to tackle and no problem too difficult for us to solve. I-T-E engineering is the best engineering there is as far as circuit breakers are concerned.

The Cutter Company, Main Office and Factory **Philadelphia**

The Cutter Company, 120 Liberty Street, New York.
The Cutter Company, Monadnock Block, Chicago.
The Cutter Company, Park Building, Pittsburgh.
The Cutter Company, Traders Bank Bldg., Toronto, Canada.
The Cutter Company, Metropolitan Life Building, Minneapolis, Minn.
The Cutter Company, Telephone Building, Indianapolis.
The Cutter Company, Woodward Building, Washington, D.C.
The Cutter Company, Ford Building, Detroit.
The Cutter Company, Pabst Building, Milwaukee.
Eccles & Smith Co., Los Angeles, San Francisco, Portland, Ore.
Electric Manufacturers Sales Company, Denve

Reasons why Century Single Phase Motors *are so popular*



They are self starting under full load, without the use of any kind of external starting device other than an ordinary knife switch to close the circuit.

They accelerate quickly (five to twenty seconds) under load.

They develop a starting torque (pull) of not less than 250% of full load torque with approximately 250% of full load current without a starter.

Their operation is practically noiseless.

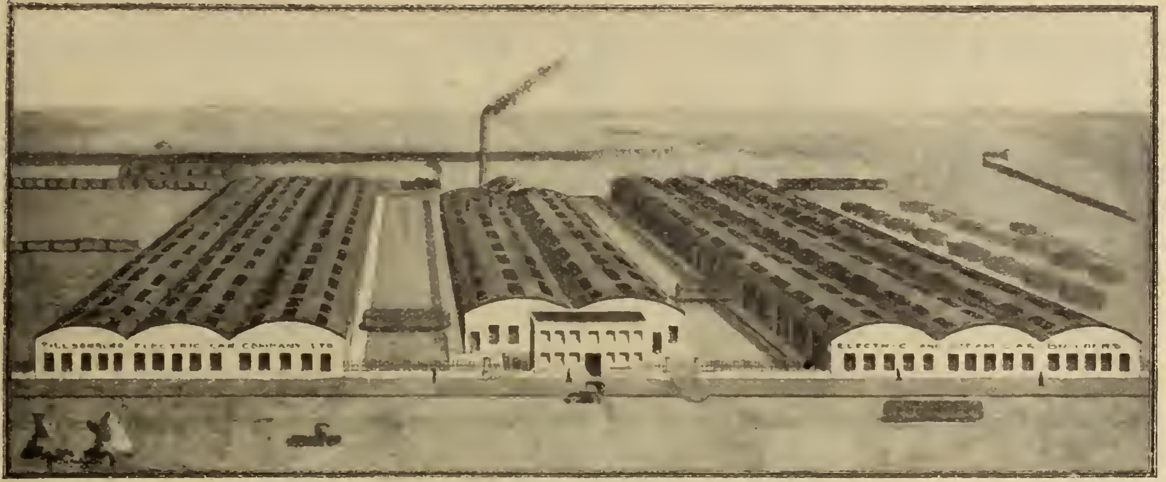
They are made by the only factory building single phase motors exclusively, consequently the design and construction can be and is kept up to conform to the most modern practice in every respect.

WE SELL THEM

The Mainer Electric Company, Limited

WINNIPEG, MAN. - EDMONTON, ALTA.

The Largest Electrical Supply House in the West



The Tillsonburg Electric Car Co., Limited

Manufacturers of

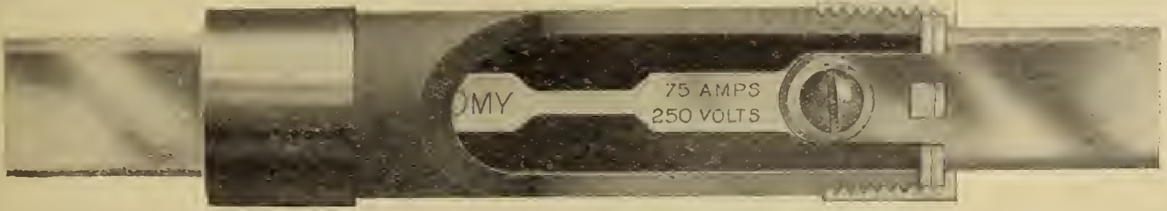
ELECTRIC CARS, SWEEPERS AND SPRINKLERS

The above illustration shows our new plant. Part of which is already erected at Tillsonburg and in operation.

The latest types of machinery have been installed and experienced workmen employed, and we are now ready to fill orders for any of our products promptly and satisfactorily.

Cut out this advertisement for future reference—an order placed with us will save you time and money.

Office and Works, - - Tillsonburg, Ontario



"Look for the Gray Shell"

Light and Power Companies, Large Corporations, Industrial Plants, Mining and Smelting Companies, Department Stores, Hotels, Office Buildings, Electric and Steam Railroads, Steamships, U. S. Government, and many other classes of users are reducing fuse Maintenance expense over 80 per cent by using

ECONOMY RENEWABLE FUSES

They use Economy Renewable Fuses for these reasons:

First, of course, because it provides a practical method of reducing the fuse maintenance expense more than 80%.
Second, because it is the only renewable fuse that is uniformly rated.
Third, because it is the only design so far produced that provides the desired electrical characteristics.
Fourth, because all capacities of renewal elements are readily available, making large fuse stocks unnecessary.
Fifth, because they never vent fire or hold a sustained arc and are absolutely safe.
Sixth, because they meet the performance specifications governing the use of such devices.

Special Announcement!

Two Economy Renewal Elements are now furnished (without charge) with each Economy Fuse. Now YOU figure what fuse is the cheapest not only to buy but also to maintain.

Write for Bulletin, Prices and Discounts

Economy Fuse & Mfg. Co. of Canada, Limited

Herald Building, Montreal

ECONOMY Renewable Fuses are sanctioned by the Canadian Fire Underwriters' Association.

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"GALVADUCT"

The Conduit that is specified for Canada's
largest buildings, grain elevators and factories.

"Galvaduct"
The Most
Perfect
Interior
Construction
Conduit
on the
Market

Recognized
as the
Standard
of High
Quality

Ritz Carlton Hotel, Montreal
A "Galvaduct" Building

"Loricated"
A High-Class
Interior
Construction
Conduit
of the
Enamelled
Type

Proof
Against Acid
or other
Corrosive
Agents

Always use "Galvaduct" or "Loricated" to carry your wiring and you will have protection and good service.

If Your Jobber Cannot Supply You Write Us

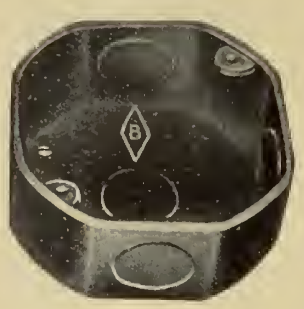
Conduits Company Limited

Toronto and Montreal

Conduit and Accessories

Approved by National Board of Fire Underwriters

GREENFIELDUCT



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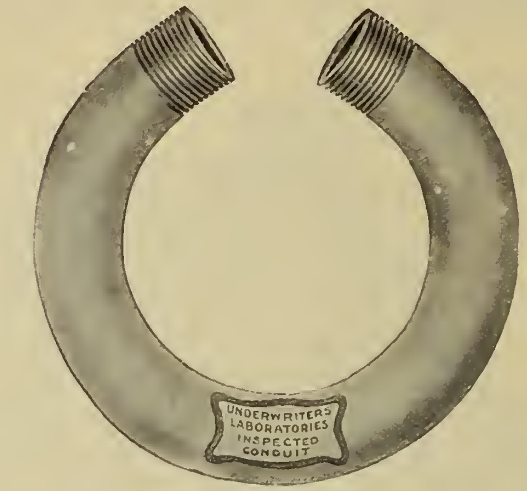
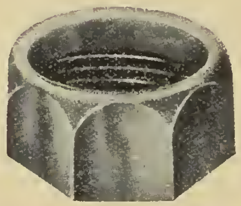


Hot Galvanized

ALPHADUCT
FLEXIBLE CONDUIT
TRADE MARK
FOR ELECTRIC WIRES



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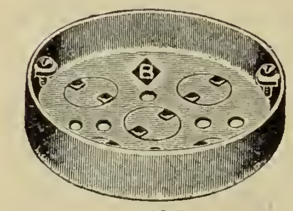

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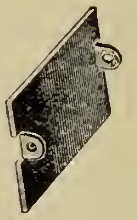

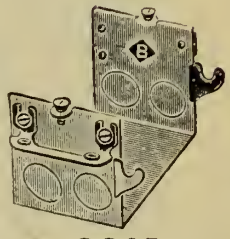

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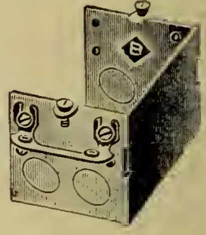

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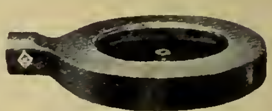


Type P

Type H

Type L B

Type J

Ask For Catalogue No. 4

Electrical Fittings Company, Limited

Toronto - Canada

Lowered Prices

A further big reduction has been made in the prices of Nulite Mazda lamps. Below are listed some of the new prices according to our revised schedules of February 1st, 1914. If you have not one of the revised schedules we would be pleased to send you one.

Nulite Mazda Lamps

PLAIN STANDARD LAMPS

FITTED WITH EDISON BASE ONLY

Sizes in Watts	Voltage	Number in Standard Package	Standard Package Price Clear	Standard Package Price Frosted
25	100-125	100	$0.38	$0.43
40	100-125	100	.38	.43
60	100-125	100	.50	.59
100	100-125	25	.86	.99
150	100-125	24	1.44	1.62
250	100-125	12	2.39	2.57

ROUND BULB LAMPS

Sizes in Watts	Voltage	Number in Standard Package	Standard Package Price Clear	Standard Package Price Frosted
25	100-125	50	$0.59	$0.68
40	100-125	24	.59	.68
60	100-125	24	.99	1.08
100	100-125	24	1.35	1.44

Remember that though Nulite Mazda lamp prices have periodically decreased since their introduction, their quality already "unexcelled" is steadily improving.

The Canadian Tungsten Lamp Co.
Limited
HAMILTON, ONTARIO
MONTREAL VANCOUVER WINNIPEG

The Best on Test

THE way to test a device is to put it in actual service. We invite you to observe the performance of Electric Weld Rail Bonds as seen on electric railways from coast to coast.

The more thorough the investigation the harder you will pull for Welded Bonds.

Write for information.

The Electric Railway Improvement Co.
Cleveland, Ohio

"SHAWMUT" Electrical Material

Enclosed Fuses
Fuse Blocks
Porcelain Cutouts
Fuse Wire and Ribbon
Fuse Links
Ground Connection Clamps
Nipples and Couplings
Stage Pockets and Plugs
Metal Cable Clips, Etc.

Manufactured by
CHASE-SHAWMUT CO.
Newburyport, Massachusetts

FRANK G. SCOFIELD
RERESENTATIVE FOR ONTARIO
702 LUMSDEN BLDG. - TORONTO, ONT.

SMALL POWER MOTORS

These motors have been specially designed and built for application to the diversified forms of small machines which may be driven by electric power. For full particulars see Bulletin 4963.

CANADIAN GENERAL ELECTRIC COMPANY
LIMITED
Manufacturers of Electrical Apparatus and Supplies for Railway, Light and Power Purposes
Head Office: Toronto. District Sales Offices: Montreal, Halifax, Ottawa, Cobalt, Porcupine, Fort William, Winnipeg, Regina, Saskatoon, Calgary, Edmonton, Nelson, Vancouver, Victoria, Prince Rupert

1896

1914

Three Million "Service Years" given by Type H Transformers

At the beginning of the new year we call your attention with a pardonable degree of pride, to the Type "H" Transformer,—its long life and its record of service rendered.

In stating the distance of the nearest star, astronomers had to establish a new unit of measurement,—the "Light Year," i. e. the distance which a ray of light will travel in the period of a year. Likewise in stating the Type "H" record of things accomplished it seems befitting to establish a new unit of measurement, which we will call the "Transformer Service Year." The number of Type "H" Transformers installed today, multiplied by the years in service gives the astounding total of over 3,000,000 "Transformer Service Years." Measured in Kilowatt hours of service rendered, this approximates the still more astounding total of thirty-two billion four hundred million Kilowatt hours of energy transformed.

During the new year let the Type "H" Transformer help to establish your record of service rendered.

CANADIAN GENERAL ELECTRIC CO.

LIMITED

Manufacturers of Electrical Apparatus and Supplies
for Railway, Light and Power Purposes

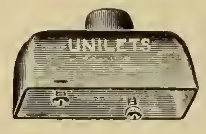
Head Office: Toronto. **District Sales Offices:** Montreal, Halifax, Ottawa, Cobalt, Porcupine, Fort William, Winnipeg, Regina, Saskatoon, Calgary, Edmonton, Nelson, Vancouver, Victoria, Prince Rupert

"UNILETS"

TRADE MARK REGISTERED

are drawn from steel and are light in weight, neat in appearance, and their durability cannot be surpassed. They are the ideal conduit fittings for up-to-date work and should be used by all contractors and those desiring their installations to be perfect in all respects. "UNILETS" are mechanically right. Furnished in either Black Enameled or Sherardized finished.

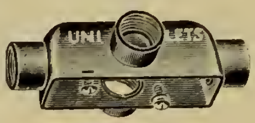
Rectangular Steel Unilets for ½″ to 3″ conduit inclusive



Cat. No. 9000

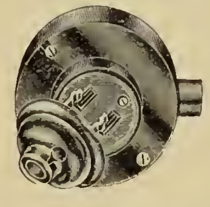
Cat. No. 9001

Cat. No. 9002

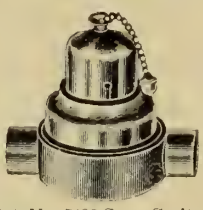


Cat. No. 9004

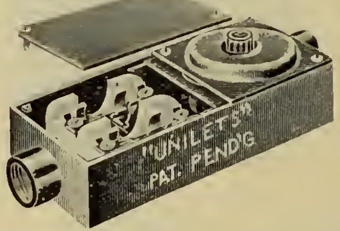
Cat. No. 9008



Type No. 1—4 inch Round Unilet with Two-phase Receptacle Attached.



Cat. No. 7402 Snap Switch Unilet with Hubbell No. 5795 Pull Switch Attached.



Combination Cut-Out and Snap Switch Unilet-Double Pole—250 volt.

Cat. No. 6906 Vapor-Proof Unilet.

Cat. No. 10 Service Entrance Unilet with No. 6003 Cover Attached.

Copy of booklet "UNILETS" sent on request

APPLETON ELECTRIC COMPANY

Main Office and Factory CHICAGO 212-214 N. Jefferson Street

For Sale in Canada by

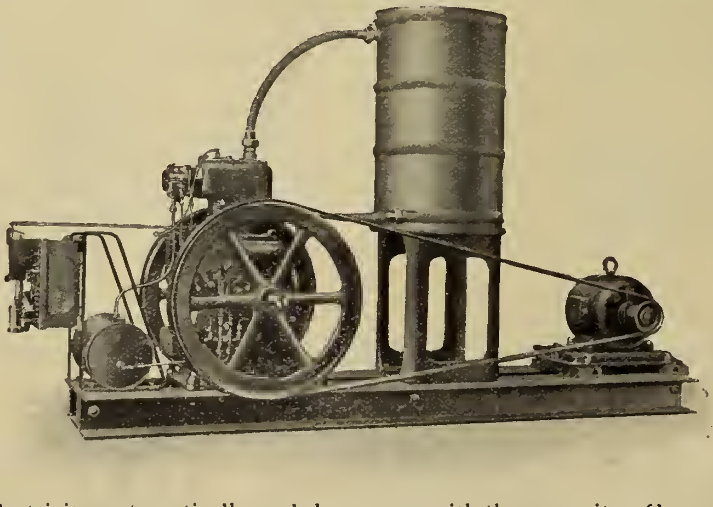
The Mainer Electric Co., Ltd., Winnipeg
Marshall-Wells Co., Ltd., Winnipeg
Chapman & Walker Ltd., Toronto

The LISTER-BRUSTON

AUTOMATIC ELECTRIC LIGHTING PLANT

Are you interested in the lighting of

- Country Houses
- Hotels
- Summer Homes
- Churches
- Factories
- Small Towns
- Villages?



A Few Purchasers

Canadian Bank of Commerce. 8 plants.
Shawville Municipality, Que. 2 plants.
House of Refuge, Cornwall, Ont.
Cleveland House, Hotel, Minett P.O., Ont.
Campbell Reeves, Esq. (Jno. Inglis Co.), Toronto.
R. A. Manning, Esq., Barrie, Ont.
Dr. Ellen Burt-Sherratt, 7 Dundonald St., Toronto.
R. Scoles, Esq., New Carlisle, Que.
W. Mosley, Esq., Weston, Ont.
R. Gordon Stewart, Esq., Ottawa, Ont.
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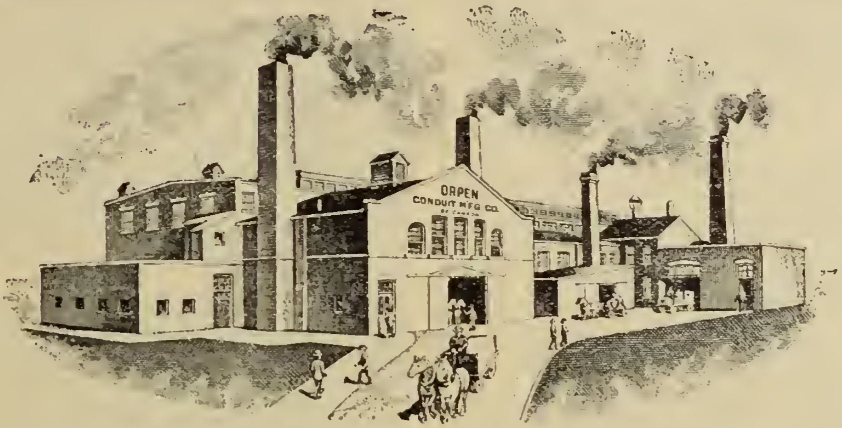
THIS PLANT generates electricity automatically and does away with the necessity of large expensive storage batteries. With the exception of keeping it clean, lubricating and filling the gasoline supply tank, no attention is required. In addition to these advantages the first cost is low, space required small and no foundations are necessary. It is delivered practically ready for connecting up to the house wiring, and can consequently be used within a few hours of being unpacked.

R. A. LISTER & COMPANY, LIMITED

Winnipeg 58-60 Stewart St., TORONTO St. John, N. B.

The home of
XCELADUCT
and
ORPENITE
CONDUITS



Queen
and
Dufferin
Streets
TORONTO

"XCELADUCT"

"Xceladuct" is a high grade of galvanized conduit made of easy-bending spellarized steel tubing, doubly protected against rust by copper plating and zinc coating. Every length is made up with clean threads and smooth enameled interior, allowing easy and rapid fishing.

INTERIOR CONDUITS

Let us send
Prices and Samples

"ORPENITE CONDUITS"

"Orpenite" Enameled Conduit is made of easy-bending spellarized steel tubing which is protected against rust and proof against all temperature conditions by coatings of specially prepared enamel. Each length presents clean threads and a smooth interior permitting of easy and rapid fishing.

THE ORPEN CONDUIT MANUFACTURING COMPANY of CANADA
TORONTO MONTREAL

"Monarch Pull Socket"

ALL CANADIAN

Created in Canada
Made in Canada
Patented in Canada
For Canadians
Why not save duty charges

These sockets have been in satisfactory service for a year.

Snap cap and shell

Made and sold by

Monarch Electric Company, Limited
ST. LAMBERT, QUE.
Write for prices

ALUMINUM

ELECTRICAL CONDUCTORS

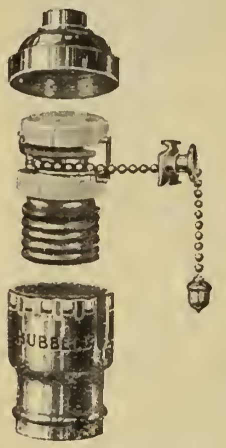
Ingot Sheet Wire Rod Tubing
Castings, Fabricated Articles

Northern Aluminum Co. Limited
1305-6 Traders Bank Bldg.
Toronto, Ont.

FELTS

Dust and Oil Rings, Buffers, Lubricating Pads, Wicks for Fan Motors, and felts of every kind for electrical and mechanical uses.

The Booth Felt Co., Limited
GANANOQUE, ONT., CANADA



No. 3000

HUBBELL

Presturn Sockets

THE STRONGEST SHELL TO HOLD TOGETHER, THE EASIEST SHELL TO TAKE APART.

Nineteen locking lugs and slots circle the cap and base. Slight pressure on the cap throws the the lugs into the slots and the shell is locked.

Press the releasing point of the shell, turn the cap and off it comes. It's a quick, slick acting shell is Presturn—adjustable at nineteen different points to allow the chain eyelet for key to be positioned wherever desired.

HUBBELL Presturn SOCKETS are easiest to install, the strongest to withstand excessive strain, the surest to satisfy your customers.

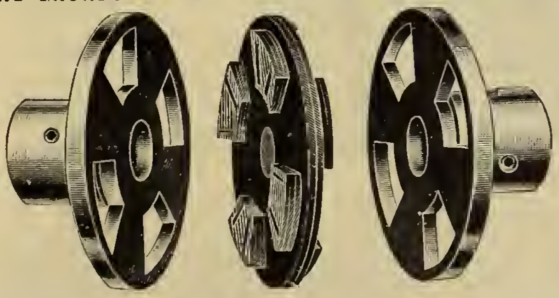
Write for sample Presturn Socket,
Pull Key or Keyless.

R. E. T. PRINGLE, 519 Can. Express Bldg. MONTREAL
TORONTO OFFICE—95 King St. East

We Purchase Outright entire issues of bonds on steam and electric railroad, gas, electric and hydro-electric properties.

N. W. HARRIS & CO.
Established 1882
Incorporated 1911
35 Federal Street, Boston, U.S.A.

THE GRUNDY PATENT FLEXIBLE INSULATED COUPLING



This coupling insulates and adapts itself to drives in which shafts are not well aligned. It is highly powerful, absolutely positive and silent. Runs either way. Practically indestructible and needs no repairs. Specify the Grundy Flexible Insulated Coupling. Details and prices are ready for you. Write.

CANADIAN BOND HANGER & COUPLING CO., ALEXANDRIA, ONT.

CHAIN-BLOCKS IN STOCK NOW, ¼ TO 30 TONS, AND ANY LIFT.

THE HERBERT MORRIS CRANE & HOIST CO. LIMITED.

EMPRESS WORKS,
PETER STREET,
TORONTO, ONT.

BRANCH OFFICE,
CORISTINE BLDG.,
MONTREAL, QUE.

One of a hundred adaptations of the

Campbell Automatic Time Switch

Switches any light, all lights, any time you wish.

Weather tight, gas tight, tamper tight—and you visit it once in 8 days.

Send for Catalog Lookit up.

Campbell Electric Co.

LYNN, MASS.

Canadian Representative—Irwin Smith, 809 Unity Bldg. Montreal

Electrical Supplies Warehouse Space

Adelaide St. W., Toronto

This new warehouse building will be well suited for the displaying and stocking of electrical supplies.

When completed it will be the most attractive warehouse building in the city The exterior, the entrances, the elevators, etc., bear all the earmarks of a high class office building.

Special Features

Centrally situated
Light on four sides
Passenger and freight elevator
Vaults
Low insurance
One block from four car lines
Floor area, 6,300 sq. feet, each floor.

For further particulars ask

R. A. Donald

Union Bank Building - Toronto

Our Improved Type "K" Meter

In the past this type of meter has won a reputation among electrical engineers and central station men for its practical design and accuracy of calibration. We show it here with its improved magnet supports and light load adjustment. The glass case permits a clear view of the interior mechanism.

IT'S A

Packard

METER

Large Stocks Carried at

St. Catharines and Winnipeg; St. John Railway Co., St. John, N. B.; General Supplies Limited, Calgary, Alta.; Rudel-Belnap Machinery Co., Canadian Express Building, Montreal, P.Q.

The Packard Electric Co., Limited

Factory at
St. Catharines, Ont.

General Sales Office
Traders Bank Building,
TORONTO

N. W. Office and Warerooms
WINNIPEG

Friction Tape

Northern
Northern
Northern
FRICTION TAPE
A very high-grade of friction tape, having high insulation, great adhesion and being moisture-proof. It will not dry out.
3/4 INCH
1/2 POUND
THE Northern-Electric AND MANUFACTURING CO LIMITED
MONTREAL TORONTO WINNIPEG REGINA CALGARY VANCOUVER

Splicing Compound

Northern, Grade A is a friction tape of extra high quality. It insures proper insulation; has extra strong adhesion and is moisture-proof.

Your orders for electrical supplies of any kind will receive prompt and satisfactory attention at any of our branch houses.

The size and completeness of the stock carried at all our houses and our splendid shipping facilities guarantees this.

Soldering Material

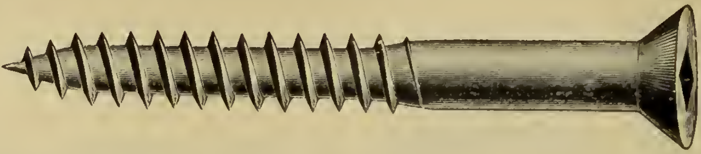
Soldering material of all kinds used in electrical work is carried at all our houses. We have also a complete stock of soldering tools including Torches and Fire Pots in several different styles.

The maximum amount of rubber is contained in Northern Special Splicing Compound. It will stand "The stretch test."

Our nearest house will send you full information desired on electrical supplies of any kind

THE Northern-Electric AND MANUFACTURING CO. LIMITED

MONTREAL HALIFAX TORONTO WINNIPEG REGINA CALGARY EDMONTON VANCOUVER VICTORIA



SEE
THAT
SQUARE
HOLE

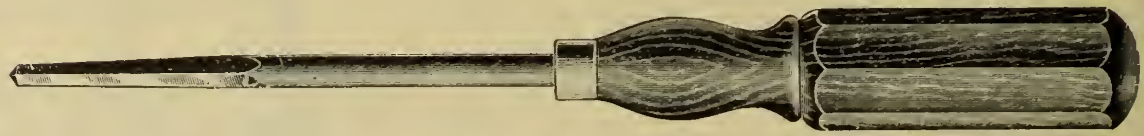
PAT. FEB. 2, 1909

ROBERTSON SOCKET HEAD WOOD SCREWS

This new socket screw can effect a wonderful saving of time and material especially in electrical wire and fixture erection, etc.

They are used by simply placing the screw on the driver and then you may reach out at arms length and drive it in with one hand. For overhead work or work between joists or under flooring it is invaluable.

Samples and prices on request

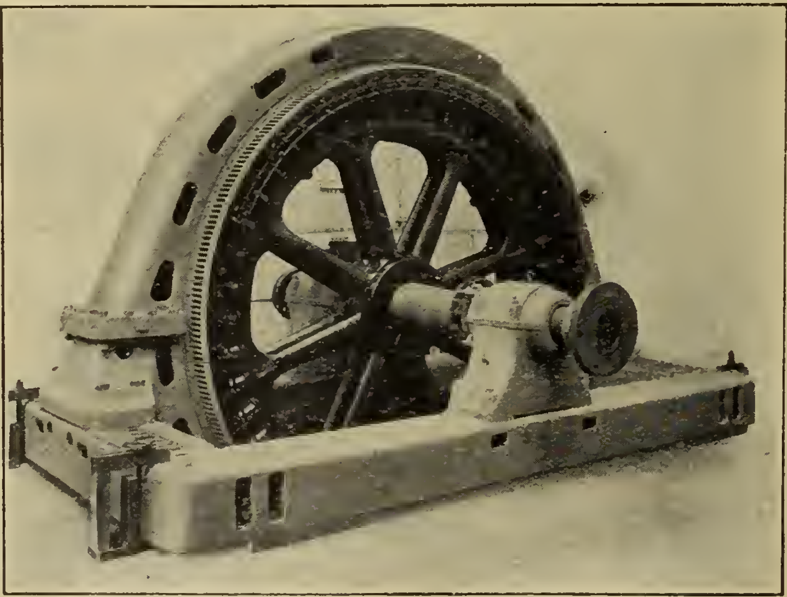


The P. L. Robertson Manufacturing Co., Ltd.
Milton — Ontario

CANADIAN VICKERS LIMITED

Patent Automatic Reversing Drive for Planing Machines

Complete Equipments for the electrical lighting and driving of machine shops, factories, etc.



3000 K. W., 6600-volt, 164 R.P.M. 3-Phase Generator for the City of Winnipeg. Five Generators have been supplied.

Turbo Generators

Motors of all types

Motor Generators

Rotary Convertors

Head Office for Canada: Lewis Building, Montreal
Mr. J. F. I. Thomas (Representative)

Works:
River Don Works, Sheffield, England

The Canadian Porcelain Company, Limited

HAMILTON, - ONTARIO

Cut shows new plant recently completed and now in operation.

We wish to announce our readiness to tender on your insulator requirements.

Our plant is modern in every respect embodying the best European and American practice in arrangement and methods.

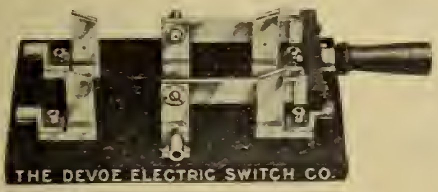
Our plant is in charge of experienced insulator specialists.

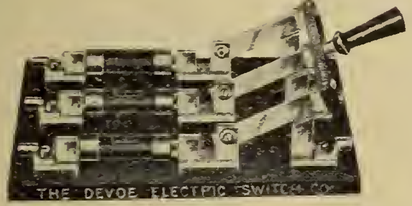
The Devoe Electric Switch Company

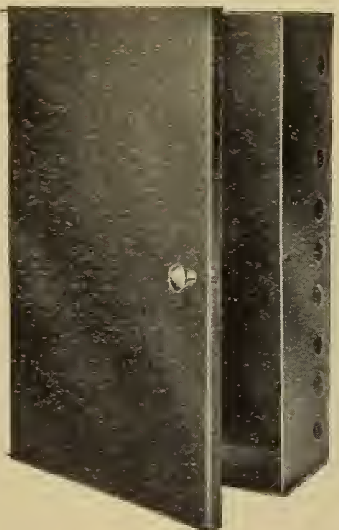
MANUFACTURERS

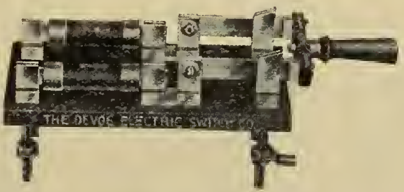
We design and manufacture SWITCHBOARDS, PANELBOARDS, CABINETS, SWITCHES and IRON BOXES of every description.

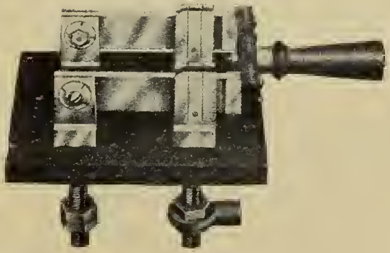
Quotations promptly made upon request when drawing or sufficient data are submitted.











Write for Switch Catalogue No. 6 and Box Bulletin No. 2.

Send us your Specifications.

Office and Factory: No. 157 Craig St. West, Montreal

Frank G. Scofield, Ontario Sales Representative, Lumsden Building, Toronto, Ontario

Double Circuit 33,000-Volt 3-Phase Crossing

of the Central Maine Power Co., over the Kennebec River at Farmingdale, near Augusta, Maine.

Towers carry wire over main ship channel, with minimum clearance of 160 feet over water at high tide.

Height of towers, 169 feet; 20 feet square at base. Main members, 6x6 angles. Span, about 800 feet.

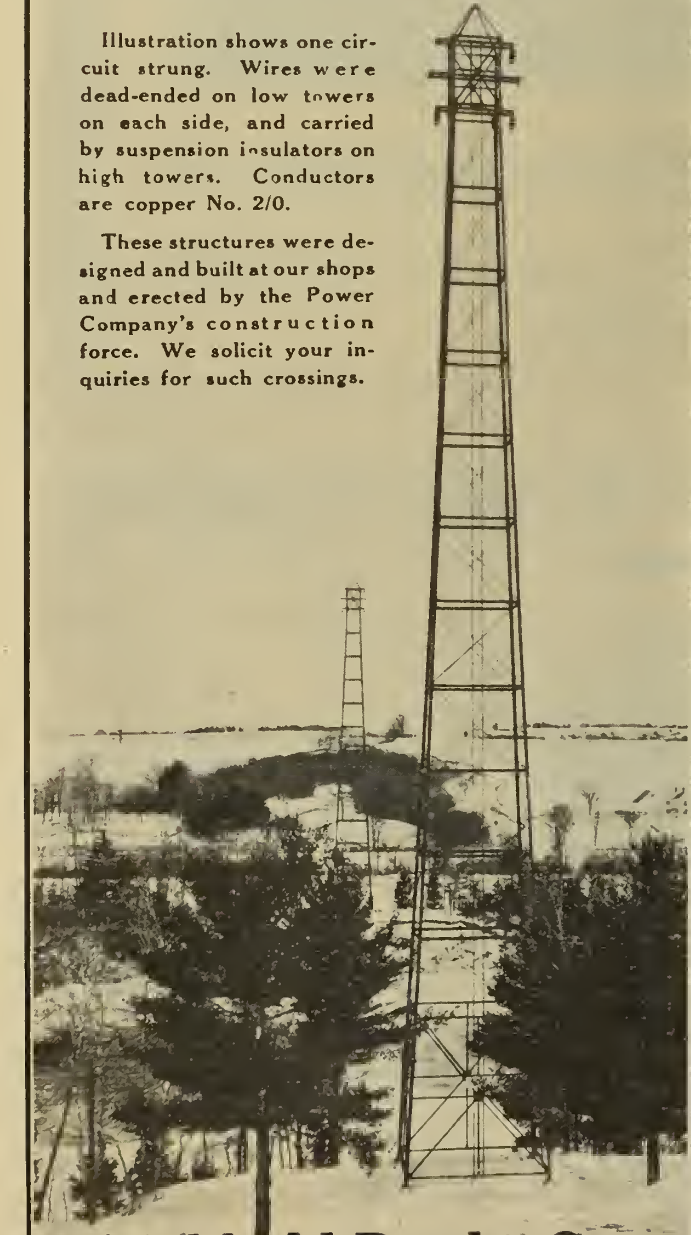


Illustration shows one circuit strung. Wires were dead-ended on low towers on each side, and carried by suspension insulators on high towers. Conductors are copper No. 2/0.

These structures were designed and built at our shops and erected by the Power Company's construction force. We solicit your inquiries for such crossings.

Archbold-Brady Co.

Syracuse, N. Y.

Special Prices

ON

Electrical Books

The Following Books are Offered Subject to Previous Sale

The Steam Turbine, by Robert M. Neilson. Published in 1903 by Longmans, Green & Co., 294 pages, illustrated. Price $1.00.

Telegraphy, by Sir W. H. Preece, K.C.B., and Sir J. Sivewright, M.A. Published in 1905 by Longmans, Green & Co., 504 pages. Price $1.00.

Electro-Dynamos, by Charles Ashley Carus-Wilson. Published in 1898 by Longmans, Green & Company, 298 pages. Price 50c.

Electrical Engineering, by Steinmetz. Published in 1909 by McGraw Hill Publishing Company. Price $3.00.

Radiation Light & Illumination, by Steinmetz. Published in 1909 by McGraw Hill Publishing Company. Price $2.50.

Electric Motors, by Crocker & Ardendt. Published in 1910 by D. Van Nostrand & Company. Price $2.00.

Direct & Alternating Current Manual, by Bedell. Published in 1911 by D. Van Nostrand & Company. Price $1.00.

Short Course in Testing Machinery, by Morecroft and Hehrs. Published in 1911 by D. Van Nostrand & Company. Price $1.

Dynamo Electrical Machinery, by Sheldon & Hausman. Published in 1910 by D. Van Nostrand & Company. Price $1.50.

Electricity—Experimentally and Practically Applied, by Ashe. Published in 1910 by D. Van Nostrand & Co. Price $1.00.

The Dynamo (2 volumes), by Hawkins & Wallis. Published in 1909 by Whittaker & Company. Price $4.00.

Hydro-electric Developments and Engineering, by Koester. Published in 1909 by D. Van Nostrand & Company. Price $4.00.

Steam Turbines, by Kennedy. Published in 1910 by Whittaker & Company. Price $1.00.

Dynamo-Electric Machinery, by Francis B. Crocker, E.M., Ph.D. Published in 1908 by American School of Correspondence. 236 pages, illustrated. Price $1.00.

Telephone Law, by A. H. McMillan. Published in 1908 by McGraw Publishing Company. 332 pages. Price $1.50.

Practical Methods of Electro-Chemistry, by F. M. Perkin, Ph.D. Published in 1905. 322 pages. Price $1.00.

Treatise on Thermodynamics, by Dr. Max. Planck. Published in 1903. 272 pages. Price $1.00.

Text-Book of Electrochemistry, by Svante Arrhenius. Published in 1902. 344 pages, illustrated. Price $1.00.

Electric Circuit Theory and Calculations by W. Perren Maycock, M. I. E. E., published by Whittaker & Co., 1913. (Just out) Price $1.00.

Electrical News

220 King Street West - Toronto, Ontario

Double-Track Safety and Capacity in Single-Track Operation

is assured by means of the

A.P.B. System

A. P. Block System means Absolute indication for opposing movements and Permissive indication for following moments.

It is the one always-safe signal system which provides for maximum single track capacity at minimum cost.

It is the one system that makes variable meeting points absolutely safe and prevents one delayed car from demoralizing the schedules. Now is the time to investigate.

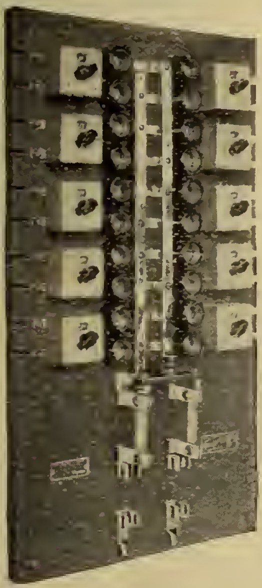
GRS "Safety First" GRS

GENERAL RAILWAY SIGNAL COMPANY
OF CANADA LIMITED

Office and Works
Lachine, Quebec

Branch Office
Winnipeg, Man. 9094B

FA PANEL BOARDS
AND
STEEL CABINETS



Meter Control Panels
and
Switchboards
are built in
Standard and Special Designs
for both
A.C. and D.C. Light
and
Power Distribution.

Write for Catalog No. 18

For Special Material Use Our Same-Day-Received Quotation - Service.

FRANK ADAM ELECTRIC CO.
ST. LOUIS, MO., U. S. A.

Use the Railway's Trolley Poles

as the basis of your new street lighting system. You can easily convert them into attractive Mazda Lamp Standards or arc lamp supports by use of

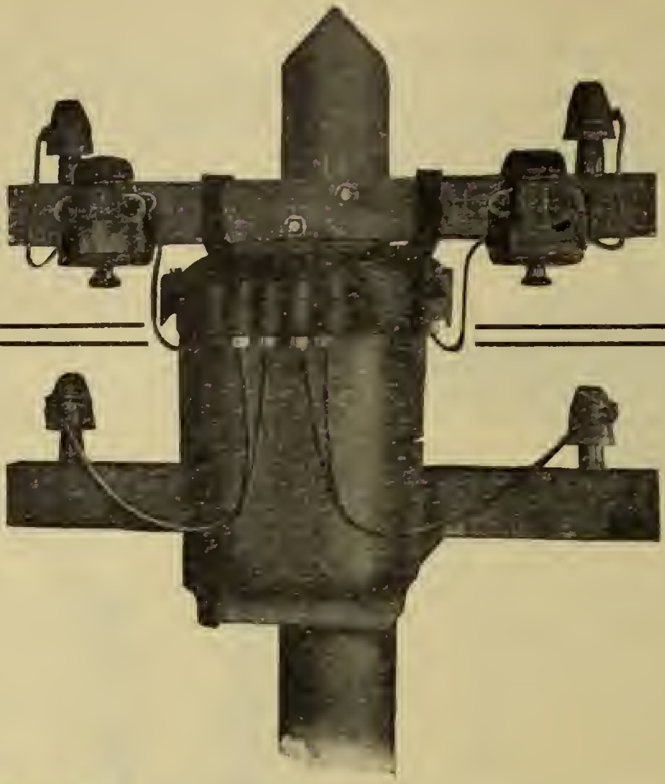
ERECO
Combination
Railway
Lighting Pole
Fixtures

This system, besides saving you the expense of underground construction, gets the wires up out of the way of traffic, where they are practically unnoticeable and the curb line is not crowded with separate lighting standards.

The progressive railway management will gladly co-operate with you with this object in view.

Design No. 10127.

Electric Railway Equipment Co.
Cincinnati, Ohio
Designers Manufacturers
Canadian Representatives:
Dawson & Co., Limited, Montreal, Winnipeg
N. Y. Office, 30 Church St., Hudson Terminal Bldg.



Moloney

on the line

For sixteen years we have manufactured high efficiency transformers— we make nothing else. Moloney transformers whether on the line or in the station will transform current with the lowest possible core loss because they are designed and built by experienced electrical engineers.

A Moloney will give high commercial efficiency every day all day long.

Buy or specify Moloney--it is best.

Our catalogue should be in your office.

Canadian Moloney Electric Co.
Limited
Windsor, Ont.

Factories at Windsor, Ont., and St. Louis, Mo., U. S. A.
825 Vancouver Block, Vancouver, B. C., Canada
901 New Electric Railway Chamber, Winnipeg, Man., Canada
1001 C. P. R. Building, Toronto, Ont., Canada
400 Lake of the Woods Building, Montreal, Quebec

Complete Stocks at **Windsor, Winnipeg, Vancouver**

Put Your Local Newspaper Behind these National Magazines

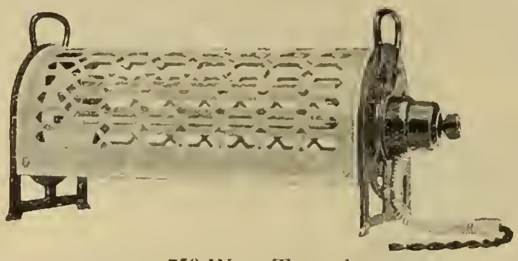
THE 1913-14 campaign of the Electric Vehicle Association is now on. Over 22 millions of people will read the story of the Electric Vehicle in thirty-six magazines. Concrete facts and figures about the economy and dependability of Electric Pleasure Vehicles and Electric Trucks will be presented.

Now is the time for you to advertise Electric Vehicles in your territory. This national advertising is bound to reach readers of America's leading magazines who live next door to your Central Station.

This potent publicity is going to reinforce the impression made by the Association's advertising in 1912-13. The Central Stations of this country gave us their loyal support then. Can we count on your active co-operation now? Remember, an advertisement for Electric Vehicles in your local newspaper during the progress of this campaign will link this nation-wide publicity to your Central Station.

ELECTRIC VEHICLE ASSOCIATION OF AMERICA

Boston 124 W. 42d St., New York Chicago



750 Watt Type A

Bastian Electric Heaters

Red Hot Glowing Quartz

Display Them to Your Customers

They Sell

THE MASCO COMPANY, LIMITED 58-60 Church St., TORONTO

"Jobbers of All Standard Electrical Goods"

The

Lachute Shuttle Co.

Limited

Lachute Mills, Que.

Manufacturers of

CROSS ARMS made from straight grained Douglas Fir, Long Leaf Yellow Pine and Red or Norway Pine.

The largest manufacturer of Cross Arms in the East.

INSULATOR TOP PINS made from Birch, Elm, Locust and Oak.

BRACKETS made from Birch and Oak.

POLE STEPS made from Oak.

STRAIN PINS made from Second growth Hickory.

SPECIAL PINS for HIGH VOLTAGE TRANSMISSION made from Locust and Oak, all kinds and sizes.

All products boiled in Parafine and Stearine or Creosoted if wanted.

CORRESPONDENCE SOLICITED

Street Illumination

By Multiples and Series

Pemco Fixtures

"The Practical Fixture"

Send for Bulletin No. 7

Philadelphia Electric and Mfg. Company

PHILADELPHIA, PA.

Canadian Representative

A. H. Winter Joyner, Limited

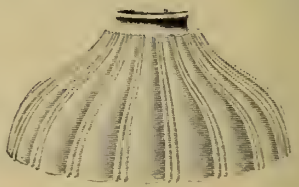
76 Bay Street, Toronto

MELILITE

Tungsten Reflectors

GILLINDER & SONS, INC.

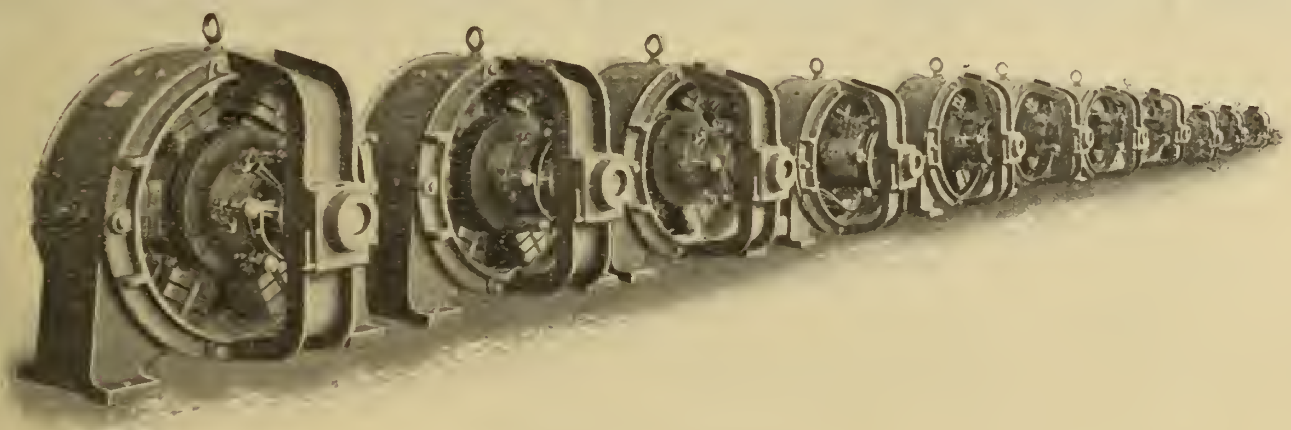
PHILADELPHIA



Swedish Electrical Machinery

Noted for

Efficiency and Workmanship



Standard Belt Driven D. C. Generators and Motors.

We solicit your specifications for Electrical Equipment

BURNHAM ENGINEERING COMPANY
LIMITED

Canadian Dealers for
The Amalgamated Electric Company of Sweden

Head Office:
Traders Bank Building,
TORONTO

Montreal Representatives:
Rudel Belnap Machinery Co., Ltd.
Canadian Express Bldg.

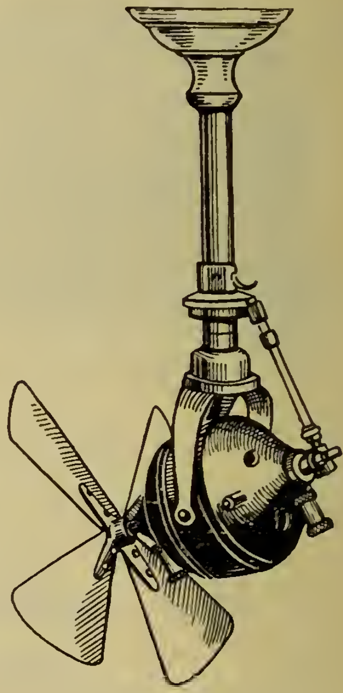
Chapman & Walker Dealer Talks

This time we want to impress upon you the advantages of placing your orders *early* in preparation for the

APPROACHING FAN SEASON

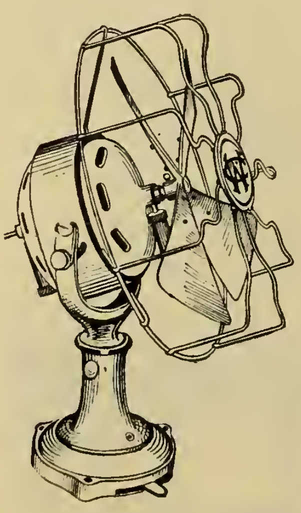
Avoid the troubles you had last season

Don't take chances this year in having your fan orders delayed and then coming along to you when the season is half over. Make sure of your order **early**— make sure of it **right now.** Send in for our **"Special Future Delivery"** contract form. It insures the delivery of your fan order in plenty of time for the beginning of the fan season.



Self Rotating Ceiling Fan

The MARK of QUALITY



Oscillating Desk Fan

We have many different styles and sizes to choose from consisting of oscillating and stationary desk, wall and ceiling types.

This year we are quoting special low prices for direct import orders.

Send us your inquiries early and make sure of early and prompt delivery.

Ask for a copy of our illustrated catalog.

CHAPMAN & WALKER, Limited

118-120 Richmond St. W., TORONTO, ONT.
VANCOUVER WINNIPEG MONTREAL

Perfect Sodering

YOU know the worth of sodering flux that can always be depended upon for a perfect joint—any metal. That positively sure flux is ALLEN-Flux, non-acid, non-corrosive—made in Stix, Paste, Liquid, Presto-Soder, also

ALLEN Sodering Salts

in pulverized form—add water and make a perfect liquid flux—better and cheaper to use than muriatic acid or anything else. Absolutely non-poisonous. We want you to try it. Send your dealer's name and 15c. for liberal sample. Your money back if not satisfied.

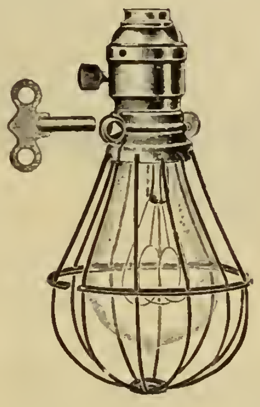
L. B. ALLEN CO., INC.
4546 N. Lincoln St., Chicago, U.S.A.
Houston & Co., Western Canada Agents
557 Henry Street, Winnipeg, Canada

TRADE MARK ALLEN REGISTERED

LOXON LAMP GUARD

THE KEY TO SAFETY

The Logical Guard To Use and Sell



It should not take much argument to convince any dealer, jobber or central station that Loxon is the satisfactory guard to sell; nor a lamp consumer that it's the best to use.

It's double protective feature Absolute Safety against both Breakage and Theft, give it a selling value you can't get away from. Its reasonable cost to users, a good profit for dealers—make it the right guard to push.

Fall and Winter is the time when Loxons save big money.

Make no mistake—

Get the genuine Loxon—Made only by

McGill Mfg. Co. 5 Oak St.,
Valparaiso, Ind.

WATERWORKS PUMPS

High duty horizontal compound and Vertical triple expansion

PUMPING ENGINES

Capacities from one-half million to thirty million gallons per twenty four hours.

Specifications on Request

THE JOHN INGLIS CO., LIMITED
Boilermakers and Engineers
14 STRACHAN AVE. TORONTO, CANADA
Montreal Office:—Room 509 Canadian Express Building

Rubber Covered Wires and Cables

For Power, Light and Telephone Work

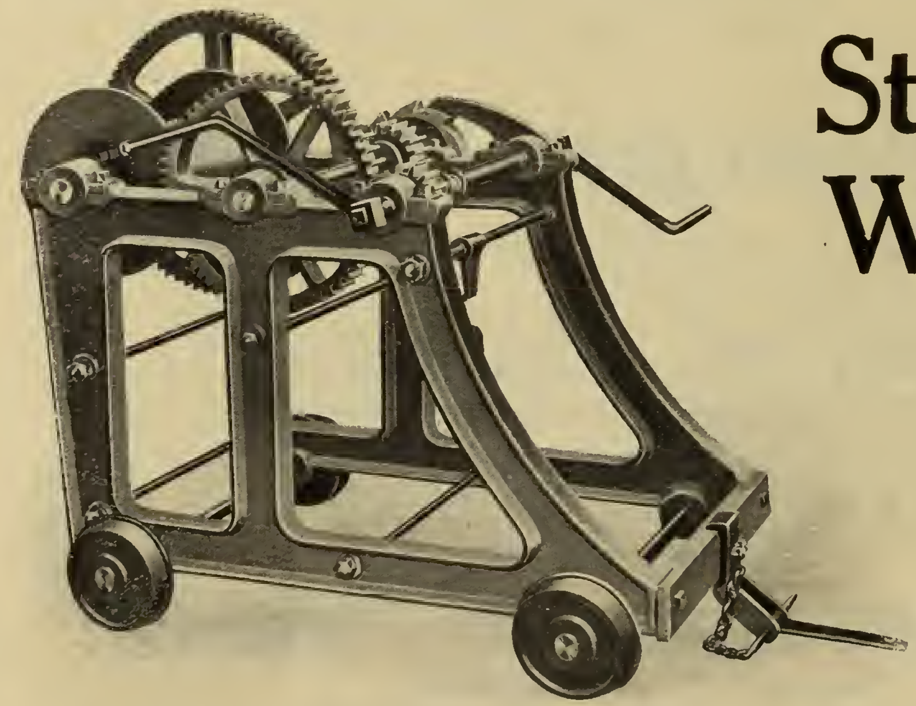
INCANDESCENT LAMP CORD
FLEXIBLE SWITCHBOARD CABLES
Special Cords and Cables for all kinds of Electrical Work

Prompt Shipments from Canadian Factory

Boston Insulated Wire & Cable Co.

CANADIAN OFFICE AND FACTORY:

Hamilton, Ontario



Stop Log Winches

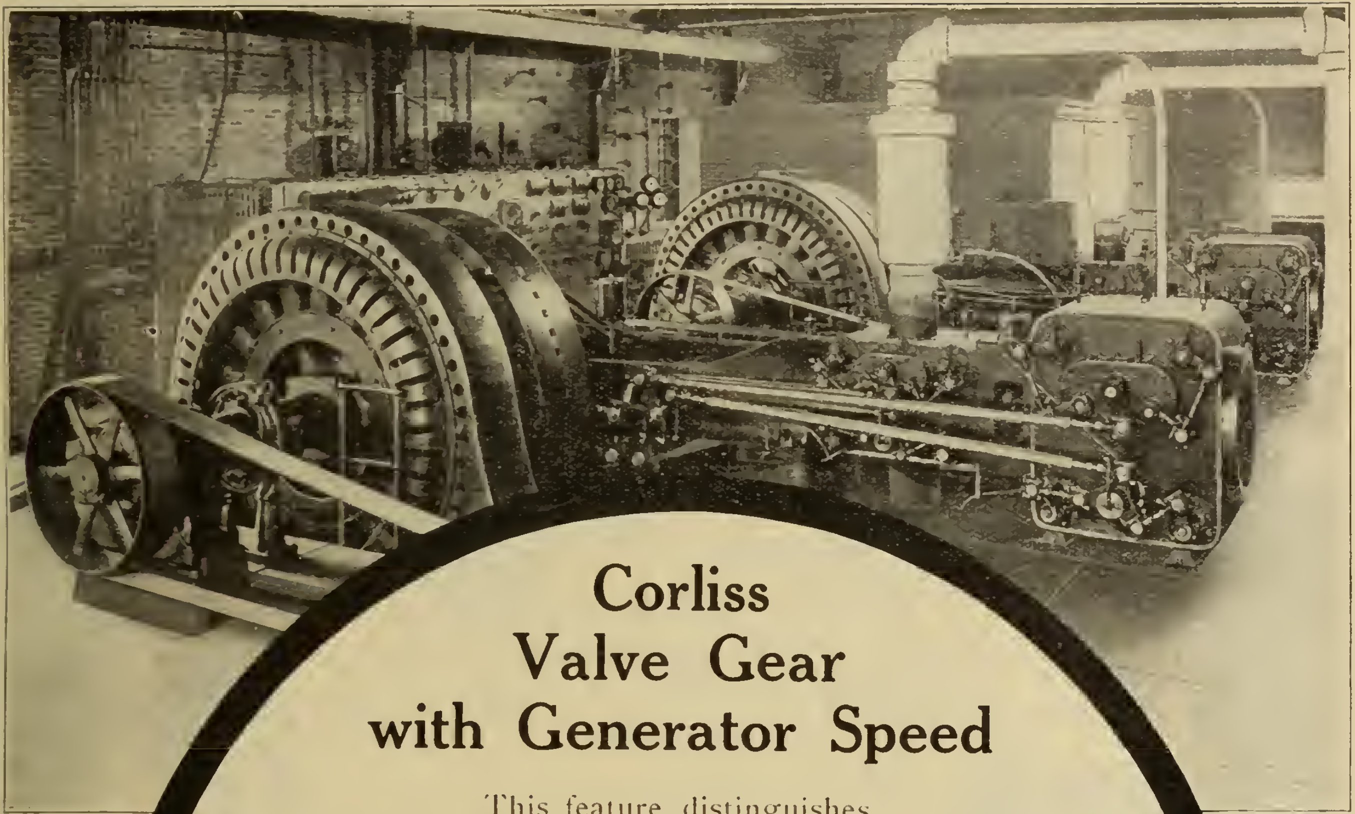
These stop log winches are double geared, have an all iron frame and are strongly built and powerful in operation.

We build a complete line of winches, headgate hoists, sluice gates, etc., suitable forall conditions.

Catalogues and drawings on request.

William Hamilton Company, Limited

Peterborough, Ontario



Corliss
Valve Gear
with Generator Speed

This feature distinguishes

Robb Corliss Engines

A simplified valve gear, multi-ported valves, short stroke, and compact frame permits a speed of 250 revolutions per minute with a moderate piston speed.

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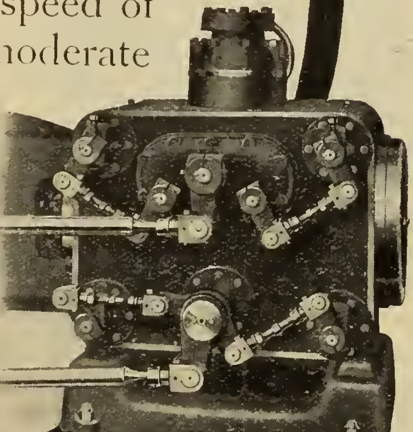

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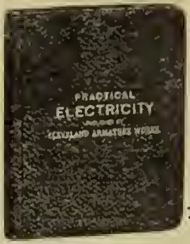

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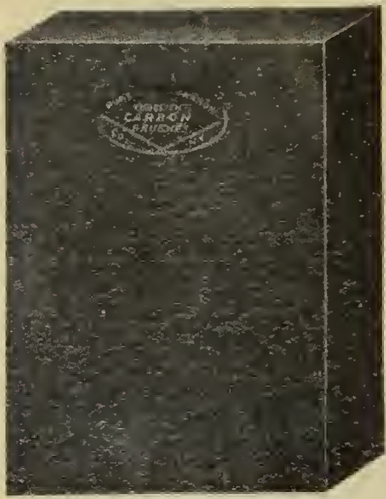

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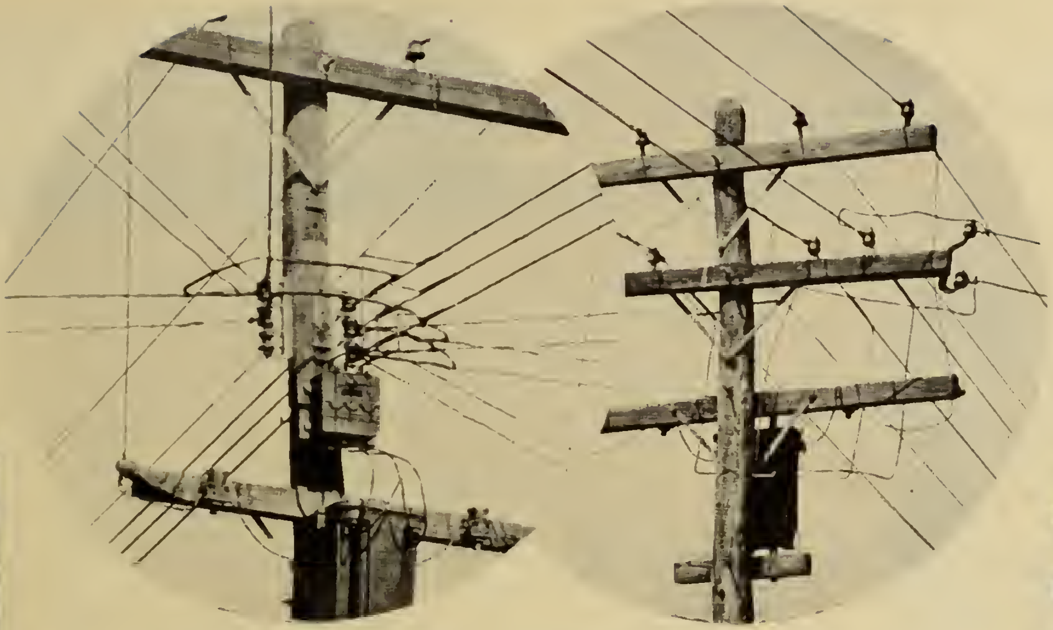

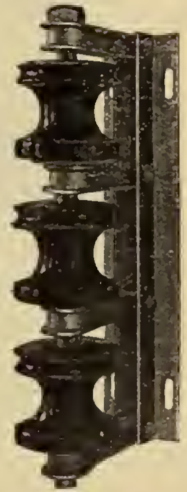

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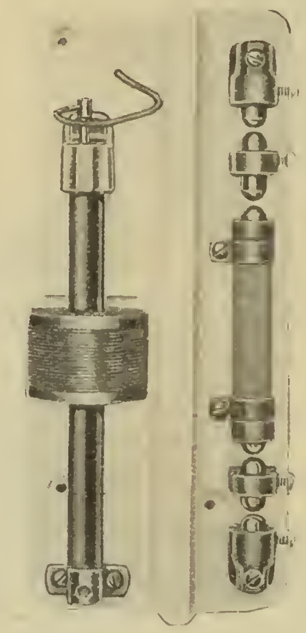

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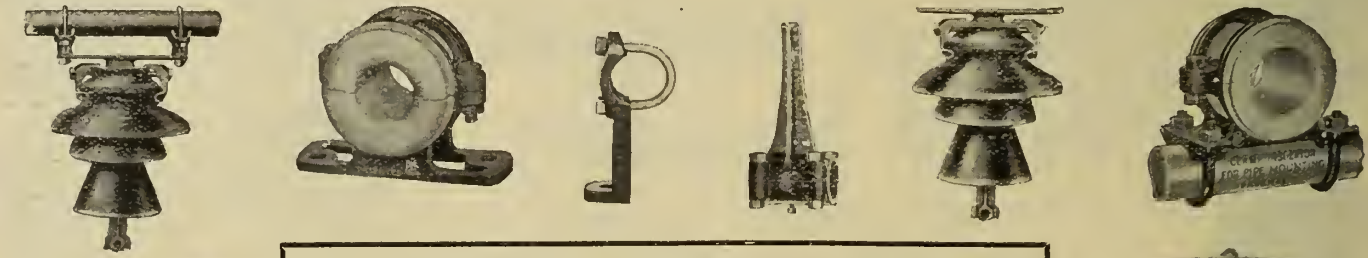

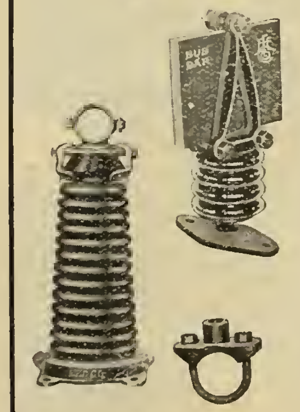

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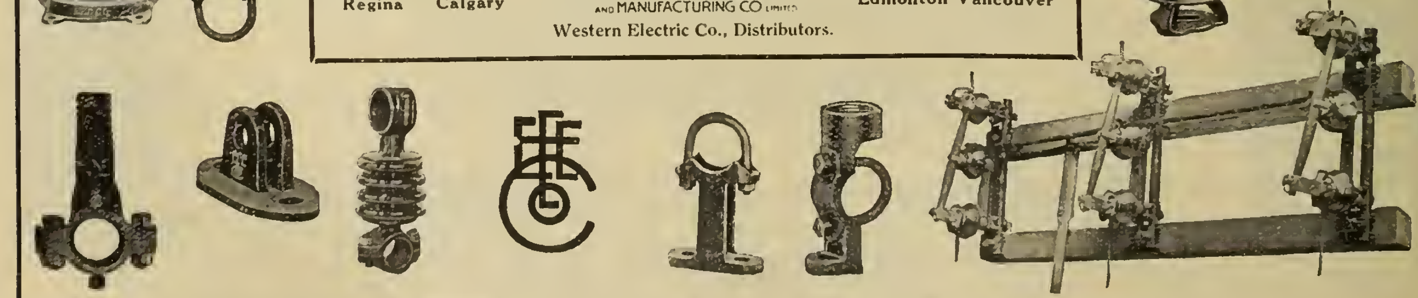

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Generation, Transmission and Application of Electricity

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Provincial Inspection Work Being Rapidly Taken Up

Municipal electrical inspection under the supervision of the Hydro-electric Power Commission is now making decided progress, and the electrical fraternity at large is beginning to realize that this work is being taken up in real earnest. Before the end of the year 1914 there will be a great many inspection departments throughout the Province. To date, the following municipalities have appointed electrical inspectors and are more or less organized for work, and in some cases have already put the Rules and Regulations strictly in force.

The first city to take the matter up was Ottawa, the work there being placed under the chief inspectorship of Mr. Norman E. Bell, late inspector of the Fire Underwriters in that city. He is assisted by Mr. Croydon and good work is being done. The other municipalities and their inspectors follow:—Port Arthur, Stirling Jaffray; Fort William, A. D. Smith; Stratford, Geo. E. Heideman; Berlin, H. C. Fischer; Goderich, W. H. Bullard; Clinton, H. B. Chant; London, W. B. Legate; Tillsonburg, John E. Teckoe; Woodstock, H. Webster; Petrolia, W. H. Somers; Parry Sound, G. Groves; Barrie, W. Macdonell; Brockville, E. J. Philip; Kingston, Thos. A. Hanley.

In addition to the foregoing the city of Hamilton have also appointed a chief electrical inspector. Up to the time of writing the appointment has not yet been ratified, as it has been made subject to the approval of the Hydro Power Commission. The town of Welland also appointed an inspector, which has not yet been ratified by the Commission, and there are some 20 or 30 other municipalities, including Toronto, now negotiating with the Commission, who will likely make appointments in the near future.

The appointment of electrical inspectors in the municipalities is subject at all times to the approval of the Hydro-electric Power Commission of Ontario, a requirement which has a tendency to eliminate the appointment of political favorites and incompetents. The appointment of municipal electrical inspectors has always been looked upon by the electrical trades as problematical, owing to the element of incompetency which has been so prevalent in the selection of men to fill the position.

The Hydro Power Commission have a department of rules and regulations under the management of an electrical inspector well known to the electrical fraternity at large, and the supervision of the various inspectors and their work will be at all times subject to the Commission, and so long as good men are selected and the Commission hold inspectors to a strict accounting of their work, the electrical contracting and engineering fraternity will have every cause to rejoice in the enforcement of the regulations.

We learn from the manufacturers and dealers in supplies that already old code wire is going begging, and in some localities cannot be disposed of for love or money.

The Influence of Fares on the Riding Habit

At the mid-year meeting of the American Electric Railway Association, Mr. F. W. Hild, general manager of the Portland Railway, Light & Power Company, discussed at length the effect, on gross earnings, of rates of fare charged on electric railways, taking the ground, which he backs by actual figures, that the fare charged is one of the least important factors regulating the extent to which street cars are patronized.

The statement will probably be received with some surprise by the average patron of street cars, but is nevertheless correct, that a comparatively small percentage of Canadian electric railways are proving profitable for the investors; possibly not more than 20 to 25 per cent. And yet street railway managements are continually confronted with requests for lower fares backed by the theoretical argument that the increased traffic would much more than offset the reduction. Actual figures, however, do not appear to bear out this theory. As Mr. Hild points out, the greatest incentive to an increased use of street cars is an improved and more frequent service. The increases must necessarily come, for the most part, in short rides, and unless the service is such that the patron can save time he generally prefers to walk. The whole question therefore appears to resolve itself into paying for what we get—good service, high rate—poor service, low rate. It is well to bear in mind also that street railway fares and the cost of electric service generally are almost the only items in our daily expense account that have not increased materially in the past few years. With increased cost of operation, higher cost of material and the demand for better service, the outlook of the future is not encouraging for cheaper transportation. Extracts from Mr. Hild's paper are printed elsewhere in this issue.

The Nitrogen Lamp

The half-watt nitrogen filled lamp which has previously been described in the Electrical News has reached Canada at last, and it is probable that installations of street lighting using this equipment will be made during the next few weeks. Already in the United States there are at least two cities using the nitrogen filled lamp, which are said to give very excellent satisfaction with low maintenance charges.

One manufacturing company has brought into Canada about half a dozen 1,000 to 2,000 candle-power lamps, one of which is at present on exhibit in Belleville, one in Toronto, and one in Hamilton. In Toronto a 2,000 candle-power unit is being tried out at the intersection of King and Yonge streets, the busiest corner in the city, and the illuminating effect is certainly very satisfactory. In sizes down to 750 watts this lamp shows an efficiency of ½ watt per candlepower, or better, though below this point the efficiency is somewhat less, gradually decreasing with the smaller sizes of lamp.

Government Reserves Water-Power Sites

Consistent with the policy of the Dominion Government to preserve the water powers for the people, the Department of the Interior is placing under reservation all vacant Dominion land that the Superintendent of Water Powers may recommend to be valuable for the development of water power.

Six whole sections of land, in township 108, range 6, west of the 5th meridian, have recently been reserved from disposition of any kind until the engineers of the Water Power Branch have had an opportunity to make a complete survey of the famous power site at Vermilion falls, on the Peace river in northern Alberta.

Similar reservations have been made on the various rivers in the provinces of Manitoba, Saskatchewan, Alberta, and in the Railway Belt of British Columbia. Particular mention might be made of reservations covering land contiguous to Grand Rapids on the Athabaska river, the various power sites on the Elbow and the Bow rivers, in the province of Alberta; for land required for the development of power at Grand rapids on the Saskatchewan river, and all unoccupied land along the Winnipeg river, in the province of Manitoba.

Other reservations will be made from time to time upon the receipt of sufficient information to enable the Superintendent of Water Powers to make a definite recommendation covering a description of the land that might be required for power purposes.

Government Estimates for 1914

The estimates of expenditure for the fiscal year ending March 31, 1915, have just been published in bound form by the Dominion government. The grand total amounts to $190,735,176, of which the two largest items are for railways and canals, chargeable to capital account, $29,983,050, and public works, chargeable to income, $28,330,048. For public works, chargeable to capital account, the estimated expenditure is $11,690,500.

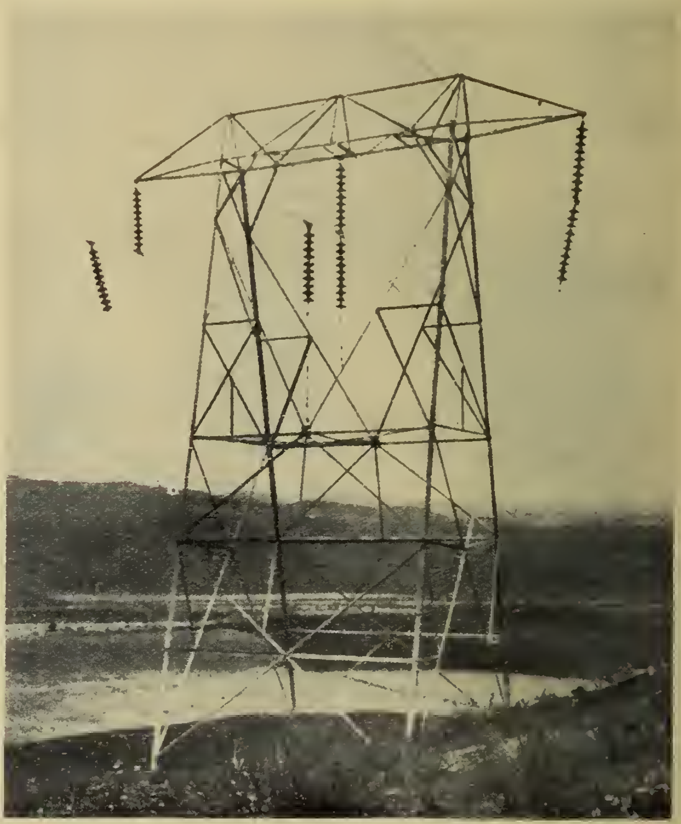
A number of items are of particular interest to electrical men in addition to the public works which consist chiefly in the construction of public buildings, in connection with all of which there will be work for electrical contractors. Of the larger items may be mentioned the installation of telephone systems in connection with the operation of the Intercolonial to cost $64,000; power plants in connection with the same road $20,000, and electrical equipment for charging the batteries on electrically lighted cars, $1,000. The re-wiring of the Ottawa legislative buildings will cost $60,000. Telegraph lines to the value of $622,000 will be constructed at different points in Canada. Another item of importance is an estimate of $370,000 to provide for the building and maintenance of wireless stations in connection with the department of naval service.

Toronto Section A. I. E. E.

Mr. N. W. Storer, of the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., recently addressed the Toronto section of the A. I. E. E. in the Engineers Club on the "Electrification of Steam Railways." Mr. Storer dealt particularly with high voltage single-phase electrification, but expressed the opinion that neither this system nor the high voltage direct current system have yet reached the limit of their development possibilities and that in the mean time it is not possible to say that any one system is the best. The latest development in high voltage a.c. trunk line work consists in the use of three-phase motors off a single-phase transmission line through phase converters. In this equipment the regenerative possibilities of the three-phase motor are utilized to the fullest extent along with its other advantages. Mr. Storer's remark that the aim of the manufacturer and operator alike should be towards the development of the best system, whether a.c. or d.c., rather than of any particular system at the expense of another, met with general approval. It must not be lost sight of, however, that the keen competition of the past among the larger manufacturers in their advocacy of their own special equipment has played a large part in the present state of high development of all the systems.

Operates 150,000 Volts

A detailed description of the 240-mile transmission line of the Pacific Light & Power Corporation, which operates at 150,000 volts is given in a recent issue of the Electrical World. Power is generated at 6,600 volts by generators of 17,500 kv.a. rating, 50-cycles, 375 r.p.m. and stepped up through 6,000 kv.a. single-phase transformers. There are two steel tower lines each carrying a three-phase circuit with the conductors in a horizontal plane. The towers are spaced on the average 660 ft. apart. Conductors are placed with a minimum clearance of 25 ft. The double tower lines are 80 ft. apart on centres.



150,000 volt line using 9-discs. Note method of tying down conductors.

The high voltage conductor is of aluminium with steel core, the outside diameter being .95 inches and the weight 4,058 lbs. per mile. The core is composed of seven strands of double galvanized plow-steel, .105 in. in diameter per strand, and the maximum stress figured for the conductor is 7,500 lbs. The conductors are spaced 17.5 ft. apart horizontally. The General Electric and the Westinghouse Companies supplied the equipment. The insulators, of course, are of the suspension type, one unit consisting of nine discs. On anchor towers two sets of 11 discs are coupled in multiple.

New Power House for Swift Current

A new power house is at present being built for Swift Current, located adjacent to the Canadian Pacific Railway. The building is of brick and concrete foundations, with steel columns and roof trusses, and is divided by a center wall into an engine room forty feet in width and a boiler room 56 feet wide, the length of the building being 61 feet. A concrete tunnel 62 feet long connects the cooling pond, which is 48 feet by 36 feet, and 6 feet deep, with the main building.

The engine or generator room is 27 feet high between the floor and the roof trusses, there being a 10-foot monitor running the length of the roof, and the walls are faced with pressed brick 8 feet from the floor. There is to be a 10-feet deep concrete basement in which the condensing apparatus will be installed. Ample light and ventilation is provided by five large steel framed windows with horizontal swing casement and monitor ventilators.

Two 2300 volt alternating current electric generators direct-connected to two high speed vertical steam engines—capable of generating 200 and 400 kilowatts respectively—will be installed, while a third large unit can be installed without extending the building. One steam engine driven and one motor driven exciter, each capable of exciting the two alternators, and a black marble switchboard on which will be mounted the high tension switches and controlling gear, are also installed in the generator room, which will be provided with one 10-ton travelling crane to facilitate the erection and repair work on the various machines.

The boiler room is to be 30 feet high from the floor to the steel roof trusses, which also carry a large monitor with ventilating casements. There will be four large steel frame windows in the west wall beneath which schutes will be provided through which coal can be unloaded from the cars on the spur track immediately outside the building direct on to the firing floor.

The foundations for two batteries of boilers, with two boilers in a battery, are being built in the boiler room, and on these three boilers, each of 300 horse power capacity, are being installed. These boilers are of the Babcock and Wilcox safety water tube type, and are equipped with superheaters which will deliver steam at 150 pounds pressure, superheated 100 degrees Fahrenheit, to the engines. These boilers will be hand fired at present, though the foundations have been made suitable for mechanical stokers, and heavy enough to carry overhead coal bunkers of 300 tons capacity to each battery.

The exhaust steam from the engines will pass into surface condensers, circulating water for which is provided in the cooling pond already mentioned, and the condensate will be pumped into an open heater located in the engine room to which the raw make-up water will be added and treated so as to provide perfectly pure soft water for feeding the boilers.

The exhaust steam from the two boiler feed pumps and the condenser pumps will be used to heat the boiler feed water, so that it will enter the boilers at from 190 to 200 degrees Fah., thus saving a considerable percentage of fuel.

The 200 kw. generator and two boilers, the feed water heater and pumps will be installed and completed this season and a temporary wooden building is being placed over them. The centre and north walls of the permanent building are being built to a height to allow of the completion of the building next spring in such a way that the plant can be kept in continuous operation during its completion.

The cooling pond will be completed this year, and will provide an auxiliary water supply during the winter, and will be ready for the condensers when they are installed next spring.

A New Principle in Transmission

By Mr. H. B. Dwight

The 240-mile transmission line of the Pacific Light and Power Corporation, between Big Creek and Los Angeles, which has recently been put in operation, is a record-breaking one in several respects. It is the longest unbroken transmission line; it uses probably a larger size of cable, and at wider spacing, than any other long distance line; and it employs a higher voltage than has previously been commercially used. Possibly more important still, although comparatively little attention has been called to it, is the fact that this difficult transmission project could probably not have been carried out as a commercial success without the employment of a new principle—that of doubling the power rating of the line by using synchronous motors to give power-factor control of the voltage. In other words, only a "constant-voltage" line is economical at the higher frequencies for distances as great as 240 miles.

This large transmission project should be of interest to all electrical men, whether they are interested in transmission lines or not, because the lesson it points regarding the actual money value of power-factor control is applicable, in a lesser degree, to a great many cases of 2200 volt work as well as other voltages up to the highest in use. It applies to many cases of city distribution as well as to transmission lines. The best methods of operating synchronous motors, and of estimating the benefits from power-factor control, are worth considerable study.

The builders of this line have published little regarding the purpose of the various features. However, more or less complete data is available, from which some conclusions regarding power transmission in general may be drawn.

The normal voltage of this 240-mile line is 150,000 volts, and the frequency is 50 cycles. The cables are of aluminum, of slightly more than 15-16 inch diameter, and with a 5-16 inch core composed of 7 steel wires. The cables are spaced 17½ feet apart in a horizontal plane. The large cable size and wide spacing allow the use of very high voltage without danger of corona loss. Two complete transmission lines have been built, each consisting of one three-phase circuit on a separate line of towers.

There are two water power plants at Big Creek. Each contains two 17,500 kva., 80 per cent. p.f. generators, and has an ultimate capacity for six generators. The total amount of power planned to be developed in these stations is thus 168,000 kw., and there is water power for even further development.

At Los Angeles the voltage is stepped down for supplying a load composed partly of induction motors for irrigation pumps and motor-generator sets for railway work. A very important feature of the receiving station consists of two 15,000 kv.a., 375 r.p.m. synchronous motors, or synchronous phase modifiers. These are being run at present without any mechanical load, for the sake of their effect on the transmission line voltage. They are adjusted automatically by Tirrill regulators to give sufficient leading or lagging current to hold the voltage constant when the load varies.

The importance of the synchronous phase modifiers is evident from a consideration of the amount of power which can be transmitted, and of the relative cost of different parts of the system. First, without any power-factor control, the maximum 85 per cent. p.f. load which one line can supply is determined as usual by the voltage variation and is 22,000 kw. This load gives 15 per cent. voltage variation from no load to full load, due to line drop, or about 22 per cent. total variation including the drop in the transformers, assuming a maximum working voltage of 150,000 volts. This is evidently a maximum allowable variation.

Allowing the same voltage variation and the same maximum working voltage, a load of 45,000 kw. at 85 per cent. p.f. can be supplied by one line when one 15,000 kv.a. synchronous phase modifier is used. Thus the synchronous machine doubles the power rating of the line. It may be mentioned that the capacity of one line has been announced to be 60,000 kv.a.

A rough estimate of first costs based on the above data gives about $1,000,000 as the cost of the material in one transmission line, while the cost of one synchronous machine, with transformers and other appurtenances, is about $120,000, at current prices. Extra power plant development must be made to supply the extra losses in the line and in the synchronous machinery when power-factor control is used, and this will cost about as much as the synchronous phase modifying machinery. While it might be out of the question to build enough of these million-dollar lines to transmit the entire power of the generating stations in the usual way without any power-factor control, the transmission may be effected commercially by building few lines and using synchronous phase modifiers.

It may be noted that if two 15,000 kv.a. synchronous phase modifiers are used, the line becomes a constant-voltage line with no variation at any point for all loads up to 42,000 kw.

In conclusion, it may be said that wherever there is a limitation to the voltage, whether due to previous construction, to the necessities of city conditions, or to corona loss, then voltage variation and the cost of lines will be predominant. In such cases, synchronous motors produce striking economies in line costs, but they must be continually adjusted with the aim of holding the voltage constant, and for this they must operate, at certain times, with a lagging power-factor. At times of heavy load they have the usual beneficial effect on the generator power-factor. Thus the common rule that synchronous motors should be adjusted so as to show 100 per cent. p.f. at all times on a power-factor meter connected to some part of the load should in many cases be changed in favor of the rule of adjusting for constant voltage.

Car of the Future—The Electric

By Dr. Chas. P. Steinmetz[*]

The future of automobiling belongs to the electric, and for the following reason: to-day automobiling is still essentially a sport and for this purpose to most people the gasoline car appears to have the advantage of being capable of higher power of motor, therefore higher speeds and to go longer distances across the country without requiring charging stations, since gasoline can be bought now almost everywhere.

You have heard from Col. Bailey's talk that the electric automobile is equally capable of long distance touring and that even to-day you can make shift by getting charges, and it is only a question of organizing a system of charging stations all over the country to make the electric touring car equally capable of going over long distances and therefore more suitable for this purpose.

However, it is not this in which I believe the main use of the automobile lies, because as I said before, it is still essentially a sporting proposition. Eighteen years ago we all thought the bicycle had come to stay as an every-day utility, as a business conveyance, still it is banished for this purpose. We don't go to work on the bicycle any more, but use other conveyance. But, nevertheless, the bicycle is to-day used just as much as it ever was used, only now it has become a business conveyance. You use it where you want to cover some distance most conveniently. Now, it is my opinion that very much of the present use of the automobile by the lawyer to go to his office, or by the engineer to go to the factory and back, is of the same class as the use of the bicycle 18 years ago—it is the thing to do—everybody who can afford it gets an automobile and runs an automobile.

Driving an engine through the streets of the city is all right for sport, but it is not feasible when the sporting idea is mixed with every-day occupation, any more than you drive your own horse except for sport; though to-day when you attend any meeting of people that own automobiles and begin to speak about automobile matters, they all can intelligently discuss them and they get very much interested talking about carburetors and spark plugs and ignition devices and so on, just as 18 years ago the same class of people were capable and interested and could as intelligently, when you mentioned the subject, talk of chain-drive and gear and bicycle tires, single tires and double tires but that is really outside of the natural inclination—is a temporary condition of sport.

Now we see already to-day the automobile beginning to recede from the sporting attitude. We see already many people that can afford it not taking pleasure in driving their own car but having a chauffeur drive it. But the majority of people cannot afford a chauffeur and they must either abandon the use of the automobile altogether or drive their own car.

Now I believe that the gasoline engine, while it is very simple and very well developed and will still be made more simple in the future, I say that it is an engine which is not much that the average business man or lawyer, or professional man who is not an engineer can handle, can take care of and take pleasure in taking care of, where they are not, as a sporting matter, interested in it. Naturally, when one is interested in an automobile as a means of diversion and sport one can do anything, but the human race as a whole does not keep up such an interest for a long time.

Now what I want to draw your attention to is—the beginning of this change of the automobile from a sporting proposition to a business proposition, from a sporting-pleasure vehicle to a business vehicle, not the pleasure of going itself, but going for business, going to some place with a definite object—that has already come.

The only car which will remain in general use is the car which everybody can take care of because it does not require any care; that means "electric" and the future of the automobile as a business vehicle, as a carriage, is the "electric" because it does not require any special knowledge, any care—anybody, any lady, can run it. The electric automobile may be, and is, capable of doing all that the gasoline car can do, but, ladies and gentlemen, I believe that, just as eighteen years ago we have seen, on a pleasant Sunday or holiday, thousands and thousands of bicycles going all over the country, from New York and Boston to Albany touring—all have vanished, likewise we will see automobiles very largely vanish from touring. The automobile is all very well, but when you wish to go for hundreds of miles the Pullman car is really more comfortable.

Now it is all right when you want to enjoy nature. People will always go out across the country on bicycles, in automobiles, on motor cycles, in horse carriages and so on, but they form a very small minority. The long distance touring car is a temporary advantage, but in the final development when the automobile has come to be an every-day affair, a business proposition and not a sporting idea, that will be a matter of secondary importance.

That means with the automobile vehicle or automobile carriage development, an electric carriage for every-day use. It means we do not need mileage of 100 miles or so. The every-day use of the average man going around town to business or elsewhere is from 10 to 20 miles a day, and a radius of 10 to 20, or possibly 30 miles will cover any business proposition—probably 95 per cent. or more. You see what that means—you can get a very small light battery, a light carriage.

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[*] Paper presented before the Electric Vehicle Association.

Now, there are many expensive gasoline cars used to-day and will be, but still with the majority the simple carriage is what is needed. True, we have the horse and buggy, but the average man cannot afford a horse and buggy because it requires care and attention to keep a horse and you cannot keep it in a city without great expense. But the average man can afford an electric carriage, because it requires no attention and there is the main future for the electric carriage—it makes the owner independent of trolley cars, independent of railroad cars and allows him to go anywhere and everywhere; and that will be, in my opinion, the main feature of the automobile in the future when the condition has become stationary, when the first enthusiasm for automobiling as the greatest of all sports will have somewhat dwindled away. It will not mean a reduction of their use, but rather, an increase. If you look into it, probably you will find that more bicycles are used to-day than there ever have been but they are not conspicuous because not any more used for sport, except occasionally.

Now, when you consider, if we had an electric carriage in every-day use it would be quite feasible to arrange for charging it at a moderate monthly cost, say $10, or $5 a month. The illuminating company or the local company in a city or country town anywhere takes care of the electric car. You run it there in the evening and in the morning you go there and take it out, it having been charged during the night. A light charge is ample for all the use you will have for it during the day.

Indeed, you may, in many cases, go further. You may arrange that a nominal additional charge be made by the illuminating company and they send the automobile to your house and leave it in front of your door and in the evening when you arrive home the illuminating company send for it. Now, it doesn't cost much extra; you can get a messenger say for 20 cents a trip, and it probably even with this would cost les than $10 a month because it isn't used every day, so it isn't probable it would cost that; it is such a small charge it is not of moment. "Oh," you might say, " what if somebody wants to use a car very much more, you would need more mileage." Well, you could have an additional charge from some other contractor, whereby you get a boost charge in your carriage from any illuminating company in the country by showing his card. It would not be difficult if both sides—the electric automobile industry and the electric operating company co-operate, have an interchange of courtesies by an annual payment or monthly payment of a certain amount, whereby the automobile is entitled to be charged everywhere and anywhere—merely run it into any illuminating company's garage, show your card, get a boost and go away again. Now, that would make it the simplest thing in the world. It would make it the ideal carriage which anybody, any lady can have, because there is no trouble connected with it, anybody can run it, any lady or child—you just telephone to the illuminating company's garage and have somebody bring it to you and when you are through with it you have somebody take it back and you have your monthly rental and that is all there is to it.

At a recent meeting of the town council a resolution was passed favoring the holding of a joint conference at Listowel to discuss the possibilities of securing Niagara Falls power and light throughout this district.

Calgary's 12,000 Volt Distribution

The drawings herewith are descriptive of the 12,000 volt distribution net work of the city of Calgary, Alberta. The city buys power from the Calgary Power Company who have a water power plant on the Bow River about 60 miles up stream in the mountains. This company delivers its power over two 55,000 volt transmission lines to the terminal station in the south-east part of the city. At this point the voltage is reduced to 12,000.

The city also owns a reserve steam plant located at Victoria Park which has a capacity of about 11,000 kw., which is generated at a voltage of 2,300. The voltage is stepped up to 12,000 by means of a 3-phase, 3000 kv.a. transformer and 3 single-phase, 1000 kv.a. transformers located in a switch house about 100 feet distant from the power house. The 12,000 volt buses of the Calgary terminal station and the Victoria Park switch house are tied in together as shown in Fig. 1.

There are 4 main sub-stations and two out-door transforming stations.

No. 1 sub-station, located on 9th Avenue and 7th Street West, is fed underground by two 12,000 volt, 3 conductor No. 00 B & S, paper insulated, lead covered cables which are routed in different duct lines to prevent trouble on one being transmitted to the other. This station is shown in the central portion of Fig. 1 where it is seen that there are two 3-phase, 3,000 kv.a. transformers installed which reduce the voltage to 2300.

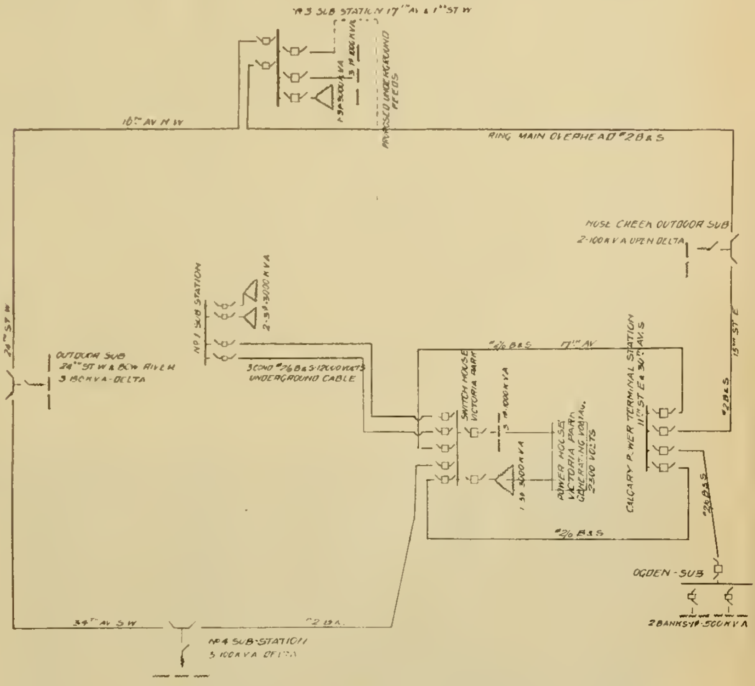


Fig. 1.—General plan of Calgary's distribution system.

Sub-station No. 2 is located at Ogden and supplies light and power to that suburb and to the C. P. R. shops; also direct current to the street railway. This sub-station is supplied at present by an overhead 12,000 volt feeder from the 12,000 bus to the Calgary Power Company's terminal station. Ultimately there will be two 12,000 volt feeders to this sub-station. In this sub-station there are two banks of three 500 kv.a. single-phase transformers.

No. 3 and No. 4 sub-stations and the two out-door transforming stations are fed from a 12,000 volt ring transmission line which surrounds a portion of the city approximately 4 miles long and 3 miles wide. The ring line is sectionalized at each sub-station so that any section of the ring can be cut out

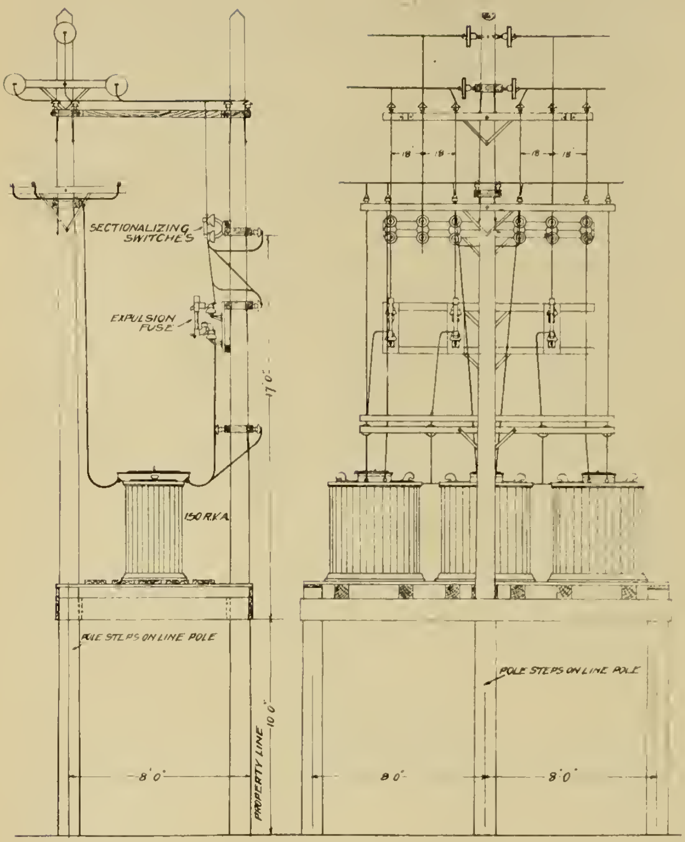


Fig. 2.—Typical outdoor transformer station.

for repairs without interrupting the service. No. 3 sub-station contains one 3-phase, 3,000 kv.a. transformer and three single-phase, 1,000 kv.a. transformers. No. 4 contains three 100 kv.a. single-phase transformers.

The two out-door sub-stations consist simply of a bank of transformers supported on a platform bolted to the line poles. On these poles are also mounted sectionalizing switches for the ring main and some expulsion type fuses for the protection of the transformers. Fig. 2 is a diagram of one of the out-door stations used at the present time. Fig. 3 shows a section through No. 1 sub-station.

In Fig. 1 will be noted a dotted line leading to sub-station No. 3 which represents the location of the proposed underground feeders to that sub-station.

The total business for the year 1913 of the electric light department in Calgary was approximately $696,000 with a surplus of approximately $70,000. This is the best year the plant has ever had both in respect to gross and net revenue. The city provides out of this gross revenue (together with all overhead operating expenses) for interest at 5 per cent., sinking fund at 2 per cent. on 30-year debentures, depreciation on the gross capitalization at 5 per cent. and a special meter fund of $1.20 per year per meter for repairs and renewals, which is equivalent to additional depreciation.

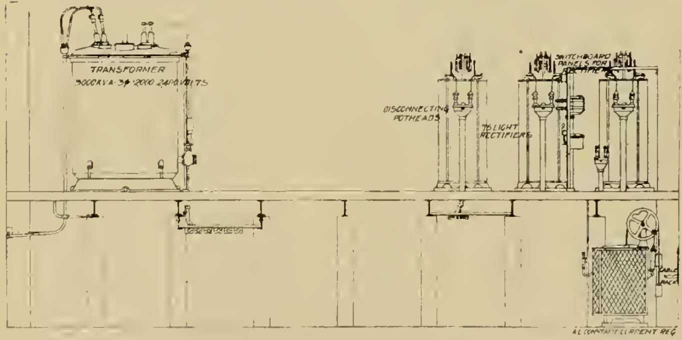

TRANSFORMER
3000 KVA 3φ 12000 2400 VOLTS
DISCONNECTING POTHEADS
TO LIGHT RECTIFIERS
SWITCHBOARD PANELS FOR RECTIFIERS
A.C. CONSTANT CURRENT REG

Fig. 3.—Section of No. 1 sub-station.

The superintendent of the electric light department of the city of Calgary is Mr. R. A. Brown under whose management this very efficient and economical system of distribution has been worked out. In this connection too it might be mentioned that the illumination of the city of Calgary is among the brightest on the continent, this city being one of the first to adopt the new magnetic arc. Much credit for the excellence of the work of this department must also be given commissioner A. G. Graves, the appreciation of whose work by the citizens was recently indicated by his re-election for another term.

Electricity in the Lumber Mill

Showing How the Advantages of Electric Drive are Being Proven in the West

The advantages of electrical drive in lumber mills have of late been recognized by modern millmen, this drive having been adopted in nearly all of the lumber mills erected during the last few years. Experience shows that it possesses the advantages of efficiency and economy and practically eliminates line shafting and belting, thus reducing the upkeep expenses to a minimum. The important features in connection with electric drive are the ability to locate the machinery where most convenient to avoid rehandling the lumber, and to operate any group of machinery or any individual machine at any time.

That isolated electrical power plants in connection with lumber mills, where fuel is available at practically no expense, has proven a commercial success, is an undisputed fact. A suggestion a few years ago that met with a good deal of incredulity was that in the near future the central station would be supplying power to operate lumber mills. This phase of the question has received an increasing amount of attention, however, and judging from the number of mills already receiving power from central stations, it is fair to assume that, where an uninterrupted service is available it possesses many advantages worth investigating by millmen.

The accompanying description of a modern electrically-driven saw and planing mill erected by E. H. Heaps & Company, Limited, at Ruskin, B.C., tends to substantiate the statement that the central station has entered the field and is apparently meeting with success. The plant and town site, occupying an area of 152 acres, enjoys an extremely favorable location, having frontage on the Fraser River and being bounded on the east by the Stave River which affords absolutely ideal facilities for holding logs. The plant commenced cutting early in 1913, running in the main side only. When completed it will have a daily cutting capacity (10 hours) of approximately 250,000 feet of lumber, 500,000 shingles and 50,000 lath. The sawmill is housed in a three-storey building, which is 402 feet long and has a width of 110 feet in one part and in its narrow portion is 64 feet wide. One side was operated for several months last season, and the second side will be fitted up in the near future as a short log mill, the machinery for which is now on order. The sawing machinery at present installed consists of a 10-ft. Allis single cut band, an 84 x 12 heavy Allis Pacific Coast edger, 7-foot Mershon band re-sawing machine, automatic air trimmers, slab slashers, etc., and a Stetson Ross automatic sizing machine. The mill is also equipped with the latest Simonson log turners, kickers, automatic transfers, etc. The planing mill occupies a building measuring 121 x 134 feet. Arrangements have been completed for the construction of the shingle mill, 35 x 120 feet, and lath mill, in time to cope with the early summer trade. The erection of the shipping shed 70 x 120 and a large drystock shed, will also be proceeded with during the early spring. Six dry kilns will be required to handle the mill output, three of these being now almost completed. The kilns are of the North Coast type, and will occupy a total space of 720 x 120 feet with stone foundations, brick walls and concrete roofing. The Western Canada Power Company at the time plans were prepared for this mill, were supplying the power for 11 motors aggregating 335 h.p. in connection with the E. H. Heaps & Company's new planing mill at Cedar Cove, Vancouver, B.C.

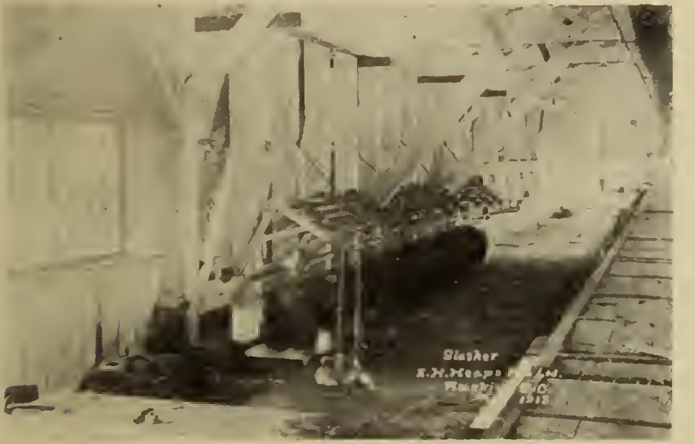


Fig. 1—Motor direct-connected to slasher.

The power at Ruskin is also bought from the Western Canada Power Company, who have erected a fireproof substation on the company's mill premises. The power is received here from the generating centre, about 7 miles distant, at a potential of 12,000 volts. It is controlled by a hand operated automatic overload G.E. oil circuit breaker, mounted on an iron frame work. From here it passes to three 12,000/400 volt Allis, Chalmers, Bullock o.i.w.c. transformers of 333 1/3 kw. capacity each. Space is also provided for another bank of three transformers of the same capacity. The power is transmitted from the transformers to the main switchboard in the mill by temporary mains consisting of three 1,000,000 c.m. cables.

The main switchboard is of special design and was built at the mill. It consists of four panels of 2-in. blue Vermont marble. Two panels are each 24-in. wide and two are 30 in. wide, giving a total width of 9 ft. The board stands 7 ft. 6 in. high and about 5 ft. from the outside wall.

On the first panel, which is 24 in. wide, are mounted:—one 7½-in. Wagner, 110 volt, a.c. voltmeter; one 7½-in. Wagner, 500 a., a.c. ammeter; one 400a, 250 v., d.p.d.t. knife switch; eight 50a, 110 v., d.p.s.t. knife switch. On the second panel, also 24-in. wide, are mounted:—one 7½-in. Wagner, 600 v., a.c. voltmeter; one 7½-in. Wagner, 2000 a., a.c. ammeter; one 2000a. t.p.s.t., type E. "Condit" oil switch. On each of the two 30-in. panels are installed two 500a., t.p.s.t., automatic, "Condit" oil circuit breakers.

There are at present four distributing panels. Panels Nos. 1 and 2 are each controlled by one 500a. circuit breaker on the main switchboard. Panels 3 and 4 are controlled from one 500a. circuit breaker, leaving one circuit breaker for future extensions to the mill.

Panel No. 1 consists of the following fuse blocks,—2 sets of 401-600a; 2 sets of 201-400a; 4 sets of 61-100a; 8 sets of 31-60a; 2 sets of 0-30a. This panel is of 1-in. marble, is 8 ft. 8 in. long and 2 ft. 6 in. high and completely enclosed in steel cabinet. All the fittings on same are polished copper and back connected. There are at present controlled from this panel the following motors, all belt connected to their machines,—

H.P.	R.P.M.	Type	What Drive
300	900	Slip ring	10-ft. Allis band mill.
40	1200	Squirrel cage	54-in. jump saw.
30	1200	Squirrel cage	Log haul.
20	1200	Squirrel cage	Conveyor.
15	1200	Squirrel cage	Conveyor.
10	1200	Squirrel cage	Roll case.
10	900	Slip ring	Conveyor.
7½	1200	Squirrel cage	Trout set works.
7½	1200	Squirrel cage	Canting gear & rock saw.
5	1200	Squirrel cage	Filing machinery.

Panel No. 2 is also of 1-in. marble, 4 ft. 8 in. long and 2 ft. 6 in. high. Fuse blocks are polished copper and back connected and consist of the following sizes:—1 set of 401-600a; 1 set of 101-200a; 4 sets of 61-100a; 2 sets of 31-60a. The following motors are at present controlled from this panel; the first two machines are direct connected,—

H.P.	R.P.M.	Type	What Drive
200	1200	Squirrel cage	84-in. Allis-Chalmers edger.
75	860	Squirrel cage	10-48" slasher saws & chains
20	1200	Squirrel cage	Transferer.
20	1200	Squirrel cage	Transferer.
10	860	Slip ring	Conveyor.

Panel No. 3 is of 1-in. marble and front connected; fuse blocks are as follows,—1 set of 401-600a; 3 sets of 101-200a; 2 sets of 61-100a; 4 sets of 31-60a. The following motors are at present controlled from this panel; the saw trimmers are direct connected,—

H.P.	R.P.M.	Type	What Drive
150	850	Squirrel cage	7-ft. Mershon resaw and transfer chain.
50	720	Squirrel cage	24-in. saw trimmers and transfer chains.
20	1800	Squirrel cage	2 cut-off saws.
15	1200	Squirrel cage	Roll cases.
10	1160	Slip ring	Conveyors.

Panel No. 4 also of 1-in. marble and front connected, contains,—4 sets of 201-400a; 7 sets of 61-100a; 2 sets of 31-60a; 1 set of 0-30a. The following motors are at present controlled from this panel; the sizer and pony edger are direct connected,—

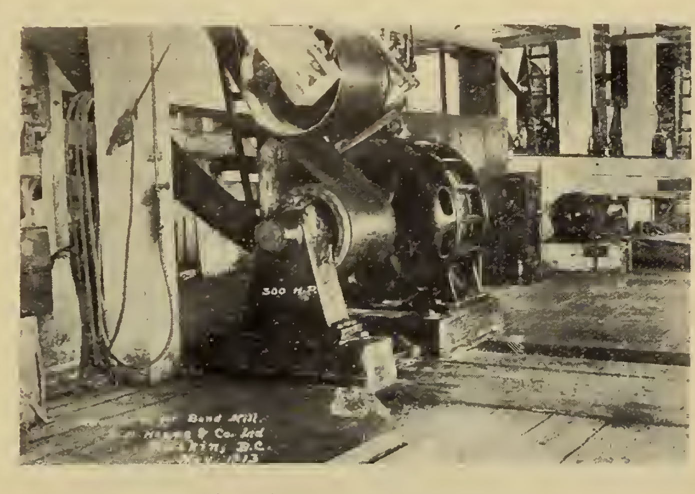


Fig. 2.—Motor drive for band mill.

H.P.	R.P.M.	Type	What Drive
50	900	Squirrel cage	Stetson & Ross sizer.
40	1200	Squirrel cage	Roll cases.
30	1200	Squirrel cage	Roll cases.
30	1200	Squirrel cage	Roll cases.
30	1200	Squirrel cage	Fan.
20	1800	Squirrel cage	Pony edger.

20	1200	Squirrel cage	Roll cases.
20	1200	Squirrel cage	Sorting table.
10	1200	Squirrel cage	Conveyor.

The Planing Mill

The planing mill, which is situated some distance from the saw mill, is supplied direct from the 440 volt busbars in the sub-station. Current is controlled by an 800a knife switch and fuses. The cables are installed under the gangway to the planing mill, entering the mill through an 800a knife switch and fuses to a slate panel 8 ft. long and 4 ft. high, front connected and containing the following fuse blocks,—1 set of 401-600a; 1 set of 201-400a; 4 sets of 101-200a; 2 sets of 61-100a; 4 sets of 31-60a; 2 sets of 0-30a. The following motors are connected from the panel; the matchers, moulder, sticker and cut-off saws are direct connected,—

H.P.	R.P.M.	Type	What Drive
75	860	Squirrel cage	Blower fan.
50	1200	Squirrel cage	6 x 15 matchers
40	1200	Squirrel cage	6 x 15 matchers.
40	1200	Squirrel cage	Berlin resaw.
30	860	Squirrel cage	15-in. wood moulder.
30	850	Squirrel cage	12-in. sticker.
10	1200	Squirrel cage	Rip saw.
5	1200	Squirrel cage	Grinding machinery.
3	1800	Squirrel cage	Swing cut-off saws.
1	1800	Squirrel cage	Knife grinders.

Provisions have been made throughout to double the size of the plant. All wiring for power and lights is in conduit, and is carried beneath the floor wherever possible to avoid interfering with machinery repairs or alterations. Distribution panels are placed at the most economical points, viz.—close to the largest motor or group of largest motors that each panel controls. The lighting is 110 volt a.c. multiple. Eight distribution panels are centrally located on the different floors, each controlled by a knife switch and fuses on the switchboard of the lighting panel. Each circuit is controlled by a knife switch and fuses and 8-16 c.p. lights is the maximum per circuit. Over sorting tables, carriage edger, slasher, trimmer and live rolls, lights are placed in an inverted trough painted white. The mill having been whitewashed throughout, very little light is absorbed by the walls. The efficiency of the lights is thus greatly improved.

All motors in the sawmill are of Allis-Chalmers-Bullock make. The band mill motor is a three-bearing type. The motors in the planing mill over 5 h.p. are of Allis-Chalmers make. Starters are provided with no voltage release. Motors of 5 h.p. and below were supplied by the Canadian General Electric Company. Every single motor in both mills is protected by a Conduit oil circuit breaker.

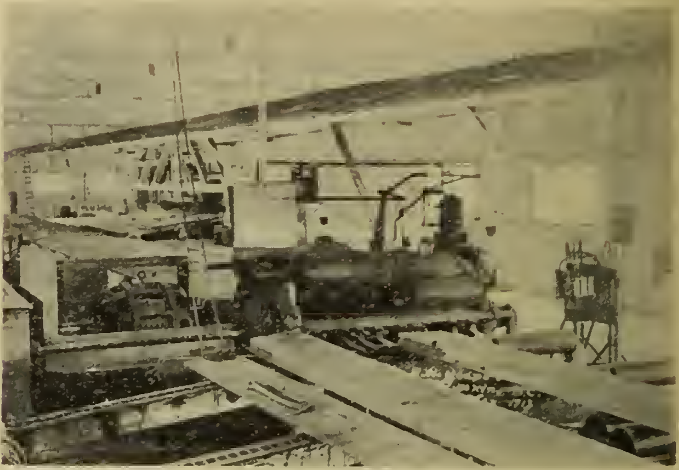


Fig. 3.—Motor direct-connected to edger.

Mr. Louis Brodeur, electrical engineer and contractor, of Vancouver, had charge of the complete installation. Mr. G. Lewthwaite, steam and electrical engineer, is now in charge of the steam and electrical plant.

Sarnia's Splendid New Electric Equipment

Following the Fire of 1911, a New Power-house and New Machinery Places this Plant in First Rank

The Sarnia Gas & Electric Light Company was organized in 1884 to supply artificial gas for lighting and in 1893 electric lighting was added. The business in the early days was exceedingly small; for instance, in 1892 there were only 150 gas meters. The original electric generator was only 50 kilowatts.

Fig. 1—New power-house, Sarnia, Ont.

Under the progressive and liberal management of Mr. W. Williams and the intelligent support he received from his directors, the business quickly developed, requiring constant additions to the power plant. In 1899 the street railway, owned by a separate company, was electrified, to be operated twenty-four hours daily and seven days a week. This company contracted to supply the electric current required for its operation. In 1908 natural gas was delivered at Sarnia from the Tilbury gas field. Arrangements were immediately entered upon to deliver the same to the citizens for all purposes of heat and light at prices that are almost negligible when convenience and comfort are considered. The business kept up a constant increase with the necessary additions to the power plant.

In 1910 the generating plant became taxed to its capacity once more. Although the service was good the style of plant had entirely outgrown itself, and it was decided to modernize the plant as well as increase its capacity. The services of Mr. J. O. B. Latour, Toronto, were retained as consulting engineer, and contracts were soon closed for direct connected generator units, including a low pressure turbine. The belt transmission from a Jack shaft was to be

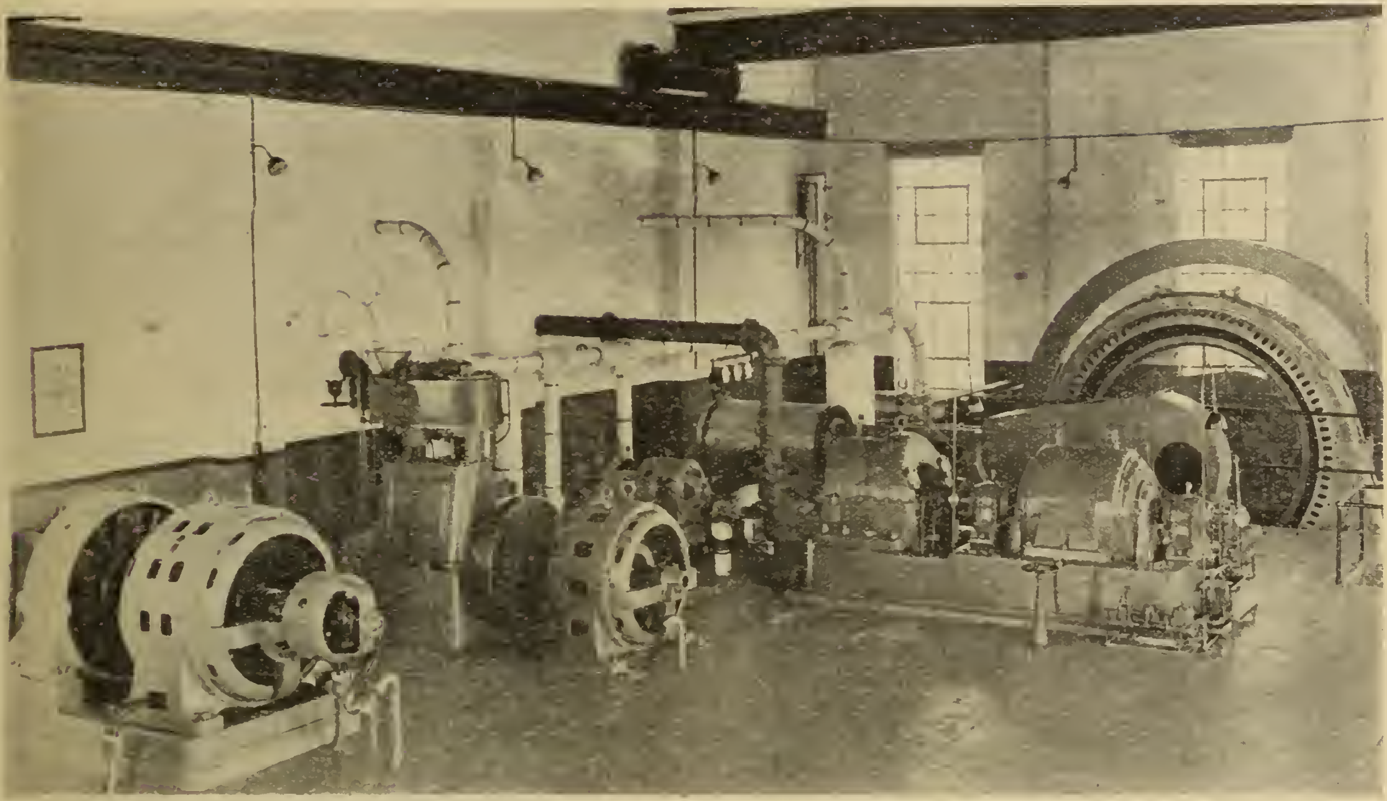


Fig. 2 General view of new plant of the Sarnia Gas and Electric Co.

eliminated. Work was also commenced to enlarge and improve the boiler house.

On the 27th of June, 1911, the plant was wiped out by fire and both lighting and street railway service crippled. This resulted in the electric lighting plant being out for the first time since it first started up. A direct connected railway engine-generator unit was secured and erected in the gas plant and as the boilers were not damaged a partial street railway service was resumed on the 12th of July. The new main generators, too, fortunately were not yet installed, so escaped damage. The low pressure turbine was erected temporarily and operated direct from the boilers through the medium of a pressure reducing valve re-establishing the lighting service on the 25th of July. If the company had not had this new machinery on hand the electric lighting service would have been crippled for a much longer time as it was impossible, at that time, to buy any electrical apparatus and secure delivery on short notice.

This experience caused the company to decide that an electric station for public supply must be fireproof. Plans were immediately prepared by their consulting engineer, and the present building constructed. The building is about 90 x 90 ft., divided into two parts, vertically, one side reserved for boilers and their auxiliaries, while the other half has a basement ten feet deep which is used for general repair shops, condensers and other necessary auxiliary apparatus. The upper section of the power house contains all the generating apparatus. The floor is constructed of I beams with arch tiles and surfaced off in concrete. All the steel is fully fireproofed. It is designed for a safe load of 450 lbs. net per square foot. This is found to be ample for all the different motor and turbo-generator sets without foundations, the reciprocating engines, only, requiring foundations, thus leaving nearly the entire basement for useful occupation. All the floors are concrete.

The basement walls are concrete 24-in. thick, and the remainder of the walls are hard brick of a red color, 18-in. thick stiffened with pilasters, spaced about 14 ft. centres. The roof is reinforced concrete and suitably covered to prevent condensation. It is supported by steel trusses. The roof is low at the centre where all the water is conducted to the hot well by a suitable pipe. This pipe is arranged to act as a ventilator for the hot well which also received all drip connections, thus preventing excess moisture in the room. This is an important factor in electric plants. The interior walls of the generating room are all plastered with lime mortar which gives the room a good finish as well as increased lighting. The windows are fitted with steel sash and wire glass. The only wood is in the four doors, but these, owing to the isolated situation of the plant, are not interfering with the fireproof regulations of the underwriters.

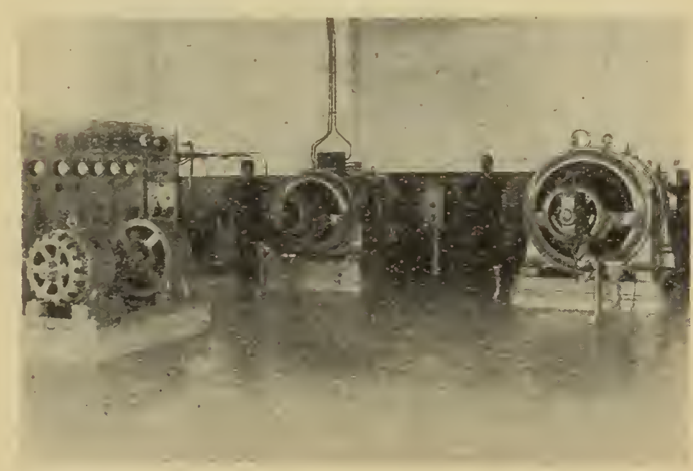


Fig. 3—Another corner, showing part of switchboard.

There are at present five horizontal return tubular boilers 72 in. diameter by 18 ft. long, except one which is 14 ft. All have 86—3½ in. tubes making a total of 750 boiler horsepower. There is room for two more similar boilers. The working pressure is 140 pounds. The room has ample height to install any style of boiler. The fuel is natural gas, but the furnaces are so designed that coal can be used without having any changes other than fuel to make. This is an important part in such a plant. There is a railway siding on the west side where a large quantity of coal can be cheaply unloaded, convenient for the firemen to pass on to the firing floor. There is a 24 in. concrete pipe connecting the cold water well with the River St. Clair. There are duplicate boiler feed water pumps of the Duplex type with outside packed water plungers. Although the boiler feed water is good, there is a water purifier designed by their consulting engineer. The water is first heated by waste steam in an open type of heater where sal-soda is added; this solution is then passed on to a reaction chamber and finally filtered; it then passes to a Worthington liquid weigher, recorded, and delivered ready for the boiler pump. All regulation is automatic.

Alternating current is generated at 2300 volts, 60 cycles and three-phase. The generating apparatus consists of one cross compound Wheelock engine 19 in. x 38 in. x 42 in., 100 r.p.m., direct connected to a Swedish General Electric 375 kv.a. generator.

One Goldie & McCulloch Company vertical compound, quick revolution, forced lubrication, engine direct connected to a Swedish General Electric 188 kv.a. generator, 450 r.p.m. One Rateau-Wait low pressure turbine direct connected to a Swedish General Eleceric 500 kva. generator, 3600 r.p.m. This all makes a total normal generating capacity of 1063 kv.a. with 25 per cent. overload capacity for three hours. There is also 50 kw., d.c. turbo-generator capacity at 125 volts. This is the first low pressure turbine installed and built in the Province of Ontario. Goldie & McCulloch Company, Galt, were the makers. It receives the exhaust of the two main engines or direct from the boilers through a pressure reducing valve. There is ample reserve floor space for a 1500 kw. horizontal turbo-generator.

The Westinghouse-Leblanc condenser, which is the first one installed in Canada, is located directly under the turbine, and maintains 28 in. or more of vacuum according to the initial temperature of the condensing water and load. The water and air pumps are driven by a Westinghouse turbine. The main engines exhaust into a 48 in. x 72 in. receiver, and can exhaust from there into a Goldie & McCulloch independent condenser, which is more convenient and economical at small loads.

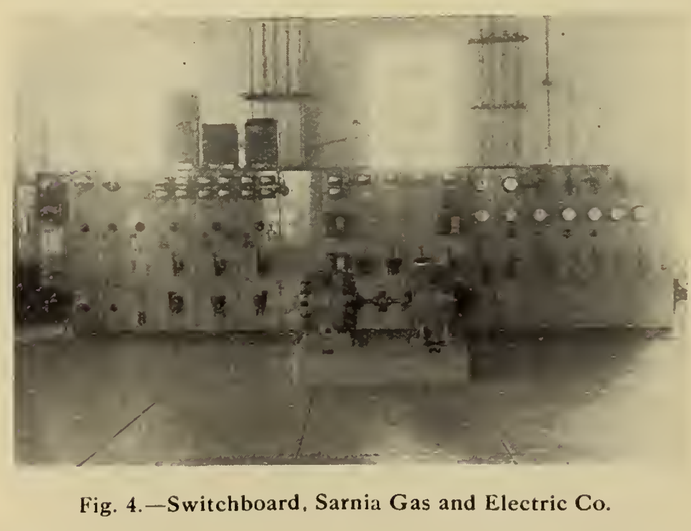


Fig. 4.—Switchboard, Sarnia Gas and Electric Co.

There are two 25 kw. Westinghouse turbo-exciter and one 15 kw. Westinghouse motor exciter sets to supply exciting current at 125 volts.

The direct 600 volt current for the street railway is generated by two Swedish General auto-synchronous motor sets of 150 kw. and 300 kw. capacity respectively. The switchboard is complete in every respect; the lighting part was supplied by the Canadian General Electric Company, and the railway part by the Swedish General Electric Company. The panels are blue Vermont marble on pipe frame work. The board is located 8 ft. from the wall and as there are three large windows behind it, the lighting during day light as well as space are all that can be desired. The instruments consist of all the necessary ampere, volt and watt meters, curve volt, watt for total load, watt for street railway load meters, synchronizing and frequency indicator and Tirrill regulator. The arc lighting is controlled by two 50-light constant current auto transformers.

The lighting of the entire station is all that can be desired. All electric cables and wiring in the plant is in metallic conduits laid in the surface of the floor or walls.

Mr. William Williams.

There is a 10-ton hand travelling crane made by Herbert Morris & Basterd, Limited, Empress Works, Loughborough, and supplied by George Tod, Toronto, which is perfect in every respect.

The citizens of Sarnia have recognized, by a constant increase of business, the efforts of the company in building such an up-to-date plant, which is an ornament as well as a guarantee of good reliable service. The officers are, Thomas Kenny, President; W. B. Collins, Wm. Storey, David Milne, J. H. Jones, Directors; Wm. Williams, Manager; J. B. Williams, Secretary-Treasurer; J. E. B. Phelps, Chief Engineer; A. G. Wheeler, Electrician. This organization is a guarantee of continuous good service and liberal treatment.

The town of Outremont, P.Q., have decided on a scheme of lighting, designed by Professor L. A. Herdt, their consulting engineer. For the present only a portion of the scheme will be carried out. Last year the council awarded a contract to Mr. G. M. Gest to construct a dual conduit for the town and for the Bell Telephone Company, and this is to be utilised for the new lighting, which will comprise 500 lamps out of the 1,100 for which the complete plans provide, which will light the main streets of the city. The standards have been specially designed by Professor Herdt, and will be surmounted by a single tungsten light.

Developments in Hydraulic Turbines

Present Practice in Design and Construction—Marked Advance in Efficiency —A Matter of Prime Importance In Canada

By Mr. H. Birchard Taylor, M. Am. Soc. M. E.

The High Capacity Runner and the Vertical Single Runner Turbine (continued)

In referring to the capacity of a runner, there is a certain relation between head, speed and power output which is best expressed by a theoretical characteristic known as "specific speed" (N_s). This characteristic was first introduced by German engineers. It gives us a means of comparing the relation between the conditions of speed, head and power of a runner in one installation with the same conditions relative to a runner in a totally different installation. This comparison is made after the conditions governing the design of both runners have been reduced to a common base, viz., specific speed.

The specific speed of a runner may be defined as the speed at which any runner will operate when it is reduced to such a size that it will develop one horse-power when operating under a head of unity. The numerical value, expressed in the metric system, of the specific speed of any runner may be found by first calculating the speed and power output of the runner under consideration for one metre head, and then mathematically reducing the runner in size until it will deliver one horse-power. The speed of this reduced runner, when operating at its point of maximum efficiency is its rated specific speed, and this speed is expressed in the formula

$$N_s = \text{r.p.m.} \frac{\sqrt{\text{h.p.}}}{\sqrt[4]{h^5}}$$

the quantities being expressed in the metric system. For converting this to the foot-pounds system of units, the formula is

$$N_s = 4.45 \times \text{r.p.m.} \frac{\sqrt{\text{h.p.}}}{\sqrt[4]{h^5}}$$

in which the horse-power and head are expressed in the foot-pounds system, while the N_s remains in the metric system. The specific speed as calculated from this latter formula is the one generally used. In figuring the specific speed of any turbine having more than one runner, the horse-power used in the formula, of course, is the output of each runner.

An examination of the formula will show that for a given r.p.m. and head, the h.p. output is proportional to the square of the specific speed; also that for a given head and h.p., the r.p.m. of a turbine is proportional to the specific speed.

Five years ago a specific speed of 275 was considered to be quite high, while to-day a specific speed of 400 is secured together with as high a maximum efficiency as was previously secured with a specific speed of 275. Thus, to-day it is possible with very high efficiency to secure for a given condition of head and power, and with the same maximum efficiency, a speed in the neighborhood of 50 per cent. greater than was possible five years ago; or, for a given head and speed, an increase of approximately 100 per cent. in the horse-power can be obtained.

With the highest specific speed which could be secured five years ago, the resulting r.p.m. for a vertical shaft, single runner turbine for low heads was, in a great majority of cases, such as to make the cost of both the turbine and generator prohibitive. During the last two years, however, with runners of increased specific speed, a much higher rotational speed can be secured for the same head and power, so that the turbine and generator designs have become thoroughly practical and economical.

Although it is true that the rotational speed secured in such a turbine is low when compared with the speed secured with turbines of the same specific speed and having two or more runners, there are many mechanical advantages involved in the use of the single runner vertical turbine for low heads which more than over-balance the increased cost of the generator.

Prominent Low Head Plants

The following are among the recent prominent low head plants for which the single runner vertical shaft turbines have been adopted:

Appalachian Power Company, New River, Virginia:
  Development No. 2, four 6,000 h.p. units, head 49 feet; speed 116 r.p.m.
  Development No. 4, three 3,500 h.p. units, head 34 feet; speed 97 r.p.m.
  These turbines hold the highest record of efficiency ever obtained, namely 93.7 per cent.
Mississippi River Power Company, Keokuk, Iowa:
  Present installation fifteen 10,000 h.p. units, head 32 feet, speed 57.7 r.p.m.
  Ultimate installation thirty units.
Georgia-Carolina Power Company, Stevens Creek, Georgia:
  Present installation, five 3,125 h.p. units, head 27 feet, speed 75 r.p.m.
  Ultimate installation, ten units.
Alabama Power Company, Lock No. 12, Coosa River, Alabama:
  Present installation, four 17,500 h.p. units, head 68 feet, speed 100 r.p.m.
  Ultimate installation, six units.
Cedars Rapids Manufacturing & Power Company, St. Lawrence River, Canada:
  Present installation, twelve 10,800 h.p. units, head 30 feet, 55.6 r.p.m.
  Ultimate installation, eighteen units.
  These will be the largest turbines in the world in point of dimensions, and will each weigh approximately 1,250,000 pounds.
Laurentide Company, Limited, Grand Mere, P.Q., Canada:
  Present installation, six 20,000 h.p. units, head 76 feet, speed 120 r.p.m.
  Ultimate installation, ten units.
  These will be the highest powered single runner vertical turbines in the world to date.
Northern Ontario Light & Power Company, Cobalt, Canada:
  Present installation, two 1,500 h.p. units, head 30 feet, speed 150 r.p.m.
Turners Falls Company, Turners Falls, Massachusetts:
  Present installation, three 9,700 h.p. units, head 54 feet, speed 97.3 r.p.m.

Had these plants been built five years ago, it would have been impossible to install vertical shaft single runner units of the same capacity, owing to the low speed and the resultant size of turbines and generators. For the same capacity, it would have been necessary to install turbines with more than one runner, or if single runner vertical shaft turbines were used, the capacity of each would necessarily have been considerably less than that of the turbines adopted, owing to the excessive dimensions with which it would have been necessary to deal.

Now consider the disadvantages of the multi-runner type of turbine.

Disadvantages of the Multi-Runner

1st. Two or more sets of gate mechanisms are required.

2nd. Equal gate openings on all runners are difficult to obtain at all degrees of opening, owing to the lost motion or torsional deflection in the gate operating shafts.

3rd. One or all of the gate mechanisms are completely submerged and are not accesible until the unit is shut down and the wheel-casing is drained. Therefore, the breakage of a gate connection may only be detected by the falling off of the power output from the generator. In addition to this, a number of the main shaft bearings are inaccessible.

4th. When multi-runner, horizontal shaft type units are installed, it is frequently necessary to have the generator floor below high tailwater level.

5th. It is often impossible to place the runners sufficiently far below the headwater surface to avoid the formation of vortices and the drawing of air into the turbines. This condition frequently impairs speed regulation as well as efficiency, and invites corrosion. When multiple runner horizontal units are set in enclosed casings, this trouble may be avoided; but another disadvantage then appears, since there is a loss of head as the water passes each wheel and draft chest, and the runners last in line have in some cases been found to be operating under a considerably reduced head.

6th. In the case of a vertical turbine having more than one runner, the depth and, consequently, the cost of substructure of the power house is necessarily much greater than in the case of a vertical shaft single runer turbine.

7th. The cost of erection and of dismantling for repairs in the case of multi-runner units of either the vertical or horizontal type is considerably more than in the case of the vertical shaft, single runner type.

8th. The opportunity for lost motion in the connections between the governor mechanism and the wicket gates is, of course, greater the larger the number of runners used with the corresponding gate mechanisms. Consequently, in the case of multi-runner wheels, there is a proportionally greater opportunity for hunting to develop in the operation of the governors than in the case of single runner turbines.

9th. In any type of turbine having two or more runners in which the runners discharge against each other into a common draft chest or chests, there is considerable loss in efficiency due to interference of discharge as already explained, unless the distance between runners and, therefore, the length of the turbine and the cost thereof, is greatly increased. The higher the specific speed, the higher is the discharge velocity from the runner buckets and, as the loss in the draft chest or tube is proportional to the square of the velocity, the loss in efficiency increases with the specific speed. It necessarily follows that in the case of high specific speed wheels, great care must be exercised in properly designing the draft chests and draft tubes. The avoidance of sharp bends in the immediate neighborhood of the runner discharge is an advantage obtainable with the single runner vertical turbine.

Advantages of the Single Runner

Among the principal advantages of the single runner unit are the following:

1st. Only one gate mechanism is required, and this is located above the head cover of the turbine and is accessible at all times for inspection while the unit is in operation. The only parts of the turbine that are submerged are the runner and the guide vanes. Repairs can be made to the gate operating mechanism without dismantling the turbine.

2nd. Owing to the fact that only one gate operating mechanism is used, involving a small number of parts, the chance for breakage is reduced to a minimum, and lost motion and deflection in the governor engine connections are avoided.

3rd. It is possible to secure in a single runner unit an ideal draft tube of long tapering section, without an obstruction or sudden turn. Therefore, with this type of wheel it is possible to use runners of the very highest specific speed, as the draft tube can be designed to convert the velocity at the discharge from the runner buckets into effective head with small degree of loss.

4th. With a single runner vertical unit, it is possible to mold in the concrete a spiral turbine casing similar in design to the cast iron spiral casings used in connection with high head turbines. It would be impracticable to prepare spiral casings for vertical or horizontal turbines having two or more runners, for obvious reasons. In a single runner turbine operating in a spiral casing, the water is directed to the runner at uniform velocity around its entire circumference, producing more uniform operation and higher efficiency thereby. In the case of the multi-runner vertical or horizontal wheels, however, it is necessary to set these wheels in open flumes or cylindrical casings, in which case the water is not guided uniformly to the runner. Consequently, the approaching water is in a more or less turbulent state from eddies and whirls. In order to eliminate excessive loss in efficiency due to these eddies and whirls, it is essential to keep the velocities extremely low in the flume by increasing the dimensions of the flume, and therefore the distance between wheel-centres.

5th. It is very often possible with turbines of the single runner vertical shaft type, to locate the runner and gate mechanism above high tailwater level, so that after the closing down of the head gates and drainage of the wheelpit, an attendant may examine all parts of the turbine without first having to pump out the wheel-chamber.

The theory of the flow of water through runners as derived from low specific speed wheels is not applicable, without modification, to the design of high specific speed runners, on account of a number of new factors which must be considered. Low speed wheels are such as are usually applied to high head turbines. The runners installed in the various units at Niagara Falls are examples of low and moderate speed types.

Exact data regarding the performance of projected turbines of large size, when the specific speed is high, can be most easily and accurately obtained through tests on a model at the Holyoke flume.

An Efficiency of 93.7%

It may be of interest to note that the experimental runner tested at Holyoke for the two 17,000 horse-power turbines recently installed in the plant of the Pennsylvania Water & Power Company, at McCall Ferry, Pennsylvania, gave an efficiency of 90.62 per cent. The actual efficiency of the large units, as approximated from the power output, is in the neighborhood of 87.5 per cent. showing a loss of approximately 3 per cent. The McCall Ferry turbines are of the vertical shaft, two-runner type, each runner discharging downward into an independent draft tube, which is the best possible arrangement for a turbine of this type. It was necessary, however, in the case of the draft tube below the lower runner to make an extremely sharp turn so as to avoid excessive excavation, and both draft tubes were so modified on account of structural conditions that the distribution of areas is hydraulically defective. The turbines are installed in open flumes of rectangular dimensions. The difference in efficiency, therefore, between the model runner and the large turbines may be easily attributed to loss due to unfavorable hydraulic conditions in both draft tubes, and particularly to the sudden turn in the lower tube, and also to the usual losses which occur in an open flume setting.

In the case of the Appalachian turbines, which are of the vertical, single runner type, having concrete spiral cases and ideal draft tubes, very exhaustive efficiency tests were made on two of the wheels, measuring the water by means of a carefully constructed weir 82 feet across the crest. The average efficiency secured in the two wheels tested was found to be 93.7 per cent. The model runner showed at Holyoke a maximum efficiency of 89.68 per cent. Consequently, the large units in place showed 4.02 per cent. in excess of the maximum efficiency secured in the model runner.

This comparison clearly indicates that the vertical single runner turbine with a spiral casing is more efficient than the experimental wheel, while the efficiency of the vertical two-runner turbine operating in an open flume is considerably below the efficiency of the experimental setting; and therefore the difference in efficiency between the vertical single runner turbine and the two-runner vertical turbine is a very appreciable amount.

There have been quite a number of horizontal two-runner units, having central discharge chests, which have been carefully tested in place. These units seldom show efficiencies above the experimental models. The only cases in which large turbines of this type have exceeded the efficiency of the experimental model have been in units of very high power having carefully designed draft chests, or in instances where the specific speed was not high; or where the experimental models used in the comparisons were tested in inefficient settings.

The advantages enumerated in favor of the single runner vertical wheel have made that type of turbine most desirable for low head installations and also for many high head developments, and undoubtedly this type of unit will be very generally adopted in the future.

Speed Regulation

In addition to considerations of efficiency, deterioration and mechanical arrangements of turbines, the question of speed regulation is of great importance where turbines are employed for driving alternators. Speed regulation is obtained by means of a governor driven from the turbine shaft, consisting primarily of a governor head containing flyballs controlled by springs and connected through a pilot valve to the main governor valve. At normal speed the flyballs hold the governor valve in its mid-position, but for any change in speed the flyballs move the valve, admitting pressure through a suitable number of relay valves to an operating cylinder so that the turbine gates are adjusted to suit the new load and to obtain the normal speed.

Some of the chief considerations in connection with speed regulation are:

1st. Sensitiveness of the governor head involving quick response to sudden changes of speed and also response to slight changes of speed.

2nd. Steadiness or stability of action. This quality is an important one and involves freedom from unnecessary gate movements or movements occasioned by conditions other than changes of load on the unit. It is not only necessary for a governor to respond to changes of load, but it is equally important that it shall not act when there is no change of load. The continual motion and vibration of the turbine gate mechanism produced by unstable governors is a source of wear and rapid deterioration of the gate mechanism which in turn accentuates the lack of stability and is very objectionable. In older types of governors this tendency was usually overcome by the use of a dashpot to damp such motions, but the use of a dashpot for this purpose renders the governor sluggish and impairs its action.

3rd. Power of governor. For large units, a large amount of power is required to actuate the turbine gates. This power may be obtained from a delicate governor head by the use of a series of relay valves controlled primarily by a small pilot valve attached to the governor head. In order to obtain sufficient fluid to move the operating piston, the main valve on the operating cylinder must be large and heavy; so that with a large unit either a considerable number of intermediate valves between the pilot valve and the main valve must be used, or else the governor head itself must be given a considerable amount of power. The same result could perhaps be accomplished by the use of high pressures in the governor system, but the use of such pressures has proved very unsatisfactory in practice and has been abandoned in favor of moderate pressures. Since time is required for sufficient fluid to flow through each valve to move the next valve in series, increase of power by such means is limited by the speed of action required. The best solution seems to be in the use of flyballs having a weight and power corresponding in order of magnitude to the turbine which they must control. Such increase in power in the flyballs involves no sacrifice in sensitiveness, since the governor head is mechanically connected to the turbine shaft and is forced to respond immediately to any change in speed of the unit. The sensitiveness will, in fact, be increased by the use of heavy flyballs, since the retarding effect of friction can be made relatively less.

4th. Reliability in operation. It is recognized by engineers of experience that delicate and complicated mechanisms should be avoided, and all machinery made to stand severe service and to be as nearly fool-proof as possible. For this reason governors in important stations should be of as simple and rugged a design as possible. The effect on a large and heavy governor of accidental conditions, such as the presence of grit in the governor fluid or sticking of the governor parts, will be slight as compared with the effects on a delicate piece of apparatus.

5th. The pressure system used was formerly divided into a separate pumping equipment for each unit in a station. This has been abandoned in favor of a single pumping system supplying the entire station. This change has greatly reduced the cost of attendance and has improved the continuity of service. The open system of governing is now being used in which oil or water for the governors is pumped from an open tank and no pressures less than atmospheric are used at any point in the system. This change avoids troubles caused by air collecting in the pipes or pumps or the breakdown of oil under high vacuum.

6th. Hand control. Another recent improvement is in the nature of the hand control used for the operation of the turbine gates. Originally the hand control of a turbine was accomplished by mechanical means through trains of gears. The mechanical efficiency of such a mechanism is so low that the time required to close the gates of a large turbine by such means is prohibitive. The mechanical hand gear was gradually replaced by a hand wheel incorporated in the design of the governor, controlling the turbine gates by oil pressure through the main valve of the governor. This arrangement, however, although it has been recently used by a number of the standard governor builders, is subject to the objection that should the governor valves be dismantled for repairs the turbine must be shut down, and it is poor engineering to dispense with the services of the turbine for the sake of a governor valve. The best method of hand control now adopted for large units, seems to be in a separate device, entirely independent of the governor and placed at a convenient point, and so designed as to admit oil from the central pumping system directly to the turbine operating engine. A restoring mechanism connection from the turbine gates maintains these gates in a position corresponding to the position of the handwheel. By this means it is possible to move by hand the gates of the turbine through their entire range in approximately ten seconds of time. Except for units of very large size, a small hand operated plunger pump may be supplied in connection with the operating stand, by means of which it is possible to create pressure for the movement of the gates in the event that the central pumping system is temporarily out of service.

7th. The mechanism of the modern governor itself has been reduced to a few comparatively simple operations. Certain compensating devices are required to restore the governor valves after the required gate movement has been produced and also to restore the speed of the turbine to the required value after the water column in the penstock, turbine casing and draft tube has had time to be accelerated or retarded to its new value. The governor should also have adjustments, so that the change in speed from full load to no-load conditions may be fixed to suit the parallel operation of alternators, also to adjust the time of action of the governor to suit the length of the velocities in the water passages and an attachment for changing the normal speed of the turbine. Modern governors are also fitted with motors by means of which the speed of the turbine can be adjusted from a distant point, such as the switchboard, this device being used in synchronizing the unit.

The above points cover all the features which can be controlled in the design of the governor itself. The speed regulation of a unit, however, depends on several other factors which are invariably of greater importance than the action of the governor itself; these are the length of and velocities in the penstock and draft tube, as well as the length of the water column in the turbine casing itself; also the "flywheel effect" of the rotating masses of the generator and turbine.

A perfect governor will be unable to produce a speed regulation better than that permitted by the factors just mentioned. These factors are controlled by the design of the power development as a whole, so that the actual speed regulation obtained is only affected to a limited extent by the construction of the governor itself. Properly, all of these factors should be considered together.

In a majority of the large installations recently undertaken, turbine governors have been designed and constructed by the builders of the turbines, thus producing a governor suited to the exact conditions of each turbine and avoiding the division of responsibility which has so often proved to be a source of annoyance. The better appreciation of the factors entering into governor problems has resulted in greatly improved speed regulation which, when taken in connection with valuable improvements in the mechanical design of the governor, has removed this important auxiliary from the class of necessary evils and placed it in that of reliable machinery.

New Plant at Grenfell

Some two months ago the town of Grenfell placed their first electric plant in operation. The plant consists of a Ruston-Proctor suction gas engine, 60 h.p. capacity, belt connected to a 30 kv.a., a.c. generator and exciter. The equipment was supplied and installed by the British Canadian Engineering & Supply Company, Winnipeg.

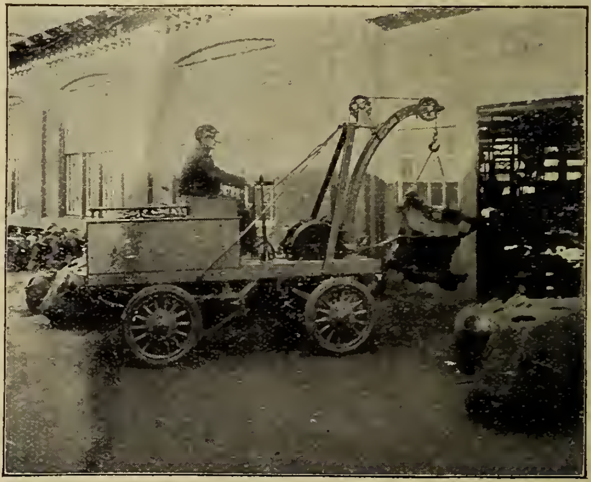
The streets of Grenfell are illuminated by 40, 100 watt series tungstens and there are already nearly 100 houses connected up, which is very encouraging for the short time the plant has been in operation. For the present the plant is run from 3.30 p.m. to 8 a.m., that is 16½ hours, and the amount of pea coal consumed daily is about 600 pounds.

Mr. Geo. Parley, electrical engineer of the town, states that the plant is operating very satisfactorily and only requires attention about every three hours. The lighting rates are 20c per kw.h. with a discount of 20 per cent. if accounts are paid within 10 days. The total cost of the plant, including the distribution system, was about $15,000. Grenfell is a splendid example of the progressive western town where they appreciate that the expenditure of a comparatively small amount of money in an electric light plant is one of the best investments a town can make.

Producer gas-electric plant at Grenfell, Sask.

A Battery Crane Truck

The truck illustrated herewith, manufactured by the General Vehicle Company is what is known as the battery crane truck. This type of truck, as well as their regular battery truck and electric trailer, have met with wonderful success during the last two or three years, as of the 2,000 lb. type illustrated herewith there are some 300 in use. The different kinds of truck mentioned may be called refinements of the simple freight truck, only with functions varying somewhat in each case. The applications of the battery truck crane are in general, hoisting, hoisting and carrying on the hook, and towing trailers. In the illustration the crane is shown handling a heavy casting. This truck has a speed on hard level surfaces of 7 miles per hour and will make approximately 25 miles on a single charge of the batteries. The current consumption for the full charging of the battery is 6 to 8 kw.h. The truck will turn in a 7 ft. radius. The crane has a wide radius being movable through a horizontal angle of over 180 deg. The rapidity with which heavy material can be moved with an electric truck results in an economy of time which is unbelievable to one who has not seen this equipment in actual operation. The fact also that the electric occupies small space and can be driven anywhere adds greatly to its economic value.



New Steam Auxiliary Plant in Kamloops

Kamloops is situated at the junction of the North Thompson and South Thompson Rivers and is destined to be a city of considerable importance due to the splendid location near the centre of the southern part of the province of British Columbia, and its convenience both as a distributing point for a very large district and as a railroad centre where the C. P. R. and C. N. R. meet on their way to the Pacific. The present population is about 5,500 people, but the growth has been so rapid during the last two years that the city has wisely planned its municipal works with a view to largely increased future requirements.

Two years ago by-laws were passed by the ratepayers for the construction of a hydro-electric power plant on the Barriere River, together with the construction of a new steam plant and sub-station, the steam plant to serve as an auxiliary and reserve to the hydro-electric plant. Provision was also made for the construction of a new concrete reservoir with initial capacity of 1,500,000 gallons. The total amount provided for by the by-laws passed for the above requirements, was about $520,000, of which $260,000 was for the hydro-electric plant to provide, by initial installation, for 2,000 h.p.; $200,000 for the steam plant and the balance for the reservoir with certain waterworks extensions to complete the system.

The carrying out of the above works was placed under the direction of Mr. H. K. Dutcher, of DuCane, Dutcher & Co., consulting engineers, Vancouver, B.C., and up to the present time, both the reservoir and steam plant have been completed, the steam plant having been placed in service on October 28th last.

The hydro-electric plant is about half completed and will be placed in service probably by the end of next summer. It is located on the Barriere River which empties into the North Thompson about forty miles from Kamloops and the transmission line to Kamloops is also expected to supply a considerable amount of power along the route for irrigation systems.

While the initial installation at the Barriere plant will provide for only 2,000 h.p.—which, with the 2,000 h.p. at the steam plant, will give the city a total of 4,000 h.p. next year, there is a possible development at the Barriere up to 20,000 horse-power.

The steam plant and sub-station recently completed is of particular interest as it also provides for a very complete pumping plant for the city water supply from the South Thompson River, and is probably one of the most modern power plants in Canada. The contract for the main building and subsidiary structures was let to Messrs. Johnson & Co., of Kamloops, and the contract for the complete installation of the plant was given to Messrs. Charles C. Moore & Co., of San Francisco.

Mr. N. M. Hall, resident engineer for Messrs. DuCane, Dutcher & Company, supervised the construction and complete installation of the plant.

Power House

The main building is of reinforced concrete construction and is 90 feet by 75 feet ground area, divided into three parts, boiler room, near the track; the turbines and pumps with switchboard in the centre, with basement for pump well and auxiliary apparatus, and on the north side the sub-station for the hydro-electric power which will come in at 44,000 volts.

The basement under the turbines is on the same level as the boiler floor and the well for the pumps is connected by 600 feet of 16-inch main to the auxiliary pump house, at the river, where the water enters by gravity, and is lifted by vertical motor pumps to the well in the power house, this arrangement being necessary to provide means of filtering the water from a filter bed to be constructed in the near future on a site near the power house.

The fuel arrangement provides for the burning of either coal or oil in the boilers, and a siding from the C. P. R. tracks enables coal to be unloaded directly into the bunkers.

Plant Equipment

The plant equipment includes four B & W boilers, 250 h.p. each, 160 lbs. per square inch working pressure, mann-

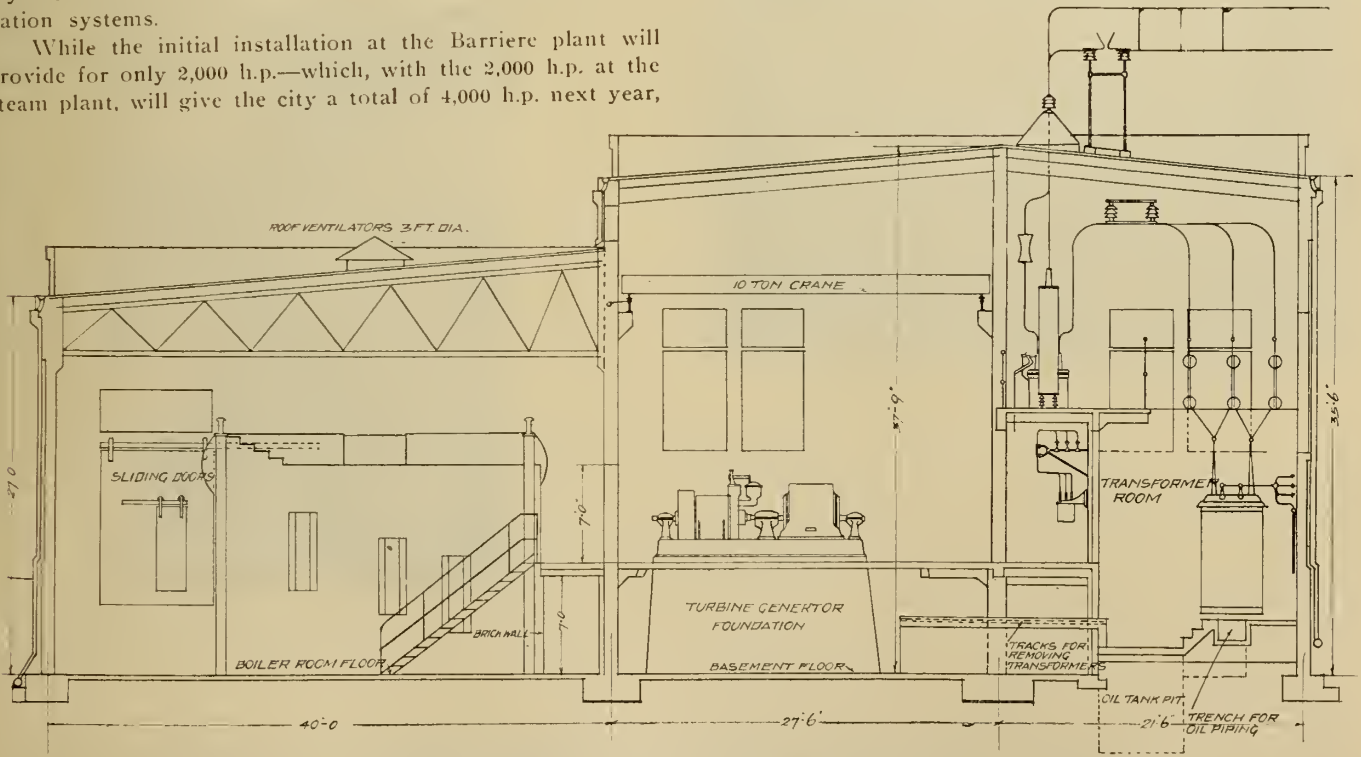


Fig. 1. Section of Kamloops new steam plant—To be supplemented by hydro electric.

factured in Scotland and supplied through the Chas. C. Moore Company. The stack is of reinforced concrete, 89 inches diameter and 180 ft. above ground level, erected by the Weber Chimney Company, of Chicago. Coal is dumped from an overhead spur into coal bunkers from which it runs by gravity into the boiler room through chutes in the rear boiler room wall. The ashes are handled by an endless chain motor-driven conveyor from hopper on boiler room level to a distance of forty feet east of boiler room; apparatus supplied by the Webster Company of Chicago, through the B. C. Equipment Company of Vancouver. There are two boiler feed pumps, supplied by the Platt Iron Works of Dayton, Ohio, through the C. C. Moore Company, and one open type Ford heater by the same firms.

The generating equipment consists of two Curtis turbo alternators, 600 kw. capacity, supplied by the Canadian General Electric Company. These operate at 3,600 revolutions per minute and are 2200 volt, three phase, 60 cycles. These units have forced oil lubrication, water-cooled bearings and electric speed changing device and over speed safety trip. The turbines exhaust into two Wheeler cylindrical surface condensers with steam turbine-driven circulating pumps and patent Edwards' air pumps. The condensers will deliver continuously from 27 to 28 inches of vacuum; they were supplied by the Wheeler Condenser and Engineering Company through the Chas. C. Moore Company.

There is one 15 kw. turbine driven exciter running at 4500 revolutions per minute, supplied by the Canadian Gen. Elec. Company and one 20 kw. motor-driven exciter running 1200 revolutions per minute, by the same firm.

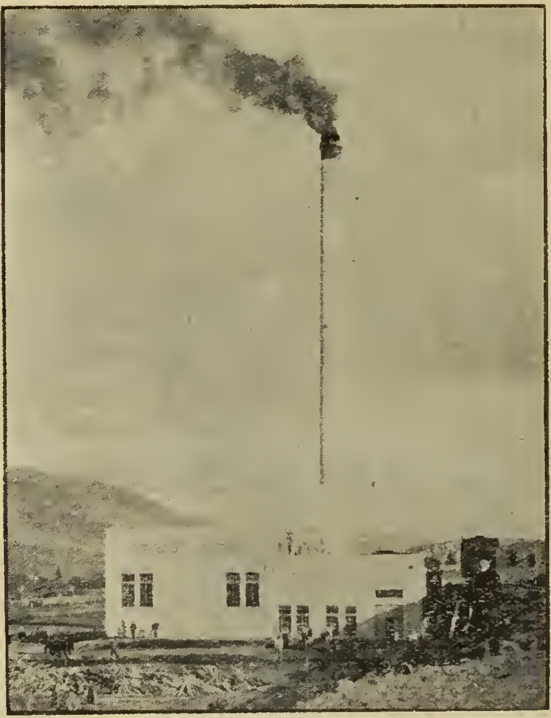


Fig. 2. Exterior of new power building.

Two induction motor-driven waterworks pumps, 1800 revolutions per minute, deliver 1200 gallons per minute into the new reservoir on the Beckman Addition. These will operate against a head of 260 to 400 feet.

There is also installed one Kerr steam-driven waterworks pump, of the same capacity, exhausting into a Wheeler waterworks type condenser with Edwards air pump. All three pumps were supplied by the Platt Iron Works through the Chas. C. Moore Comany, the motors by the Canadian General Electric Company, and the turbine by the Kerr Steam Turbine Company, of Wellsville, N.Y. These three pumps discharge through a Simplex Venturi meter with indicating curve drawing and integrating apparatus to register the water pumped into the city mains. The suction is from a 25,000 gallon tank directly under the pumps and supplied from the river by two vertical motor-driven centrifugal pumps situated in the auxiliary pump house on the bank of the South Thompson River. These pumps will discharge 1,500 gallons per minute against 50 feet head and were supplied by the Canadian General Electric Company.

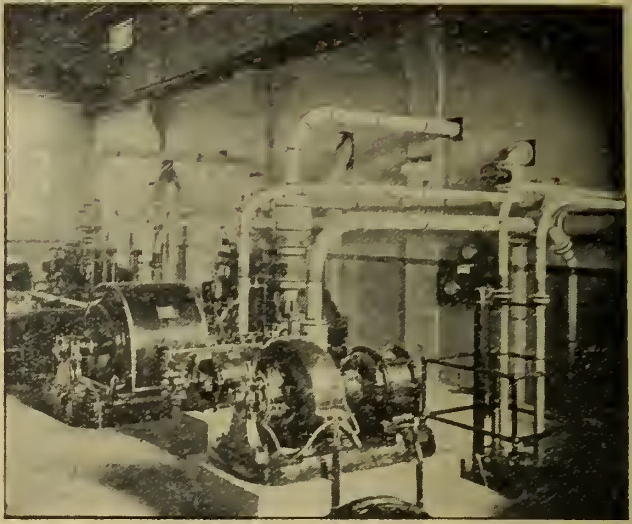


Fig. 3. Steam turbines and piping Kamloops.

The switchboard, which is of natural slate, consists of 19 panels. The board is of very neat design and when lighted up presents a very fine appearance. All high voltage wiring, oil switches and apparatus which would prove dangerous to the operators are on a structure at some distance to the rear of the switchboard and there is no apparatus actually on the panels at a potential above 110 volts. A completely equipped station lighting panel box distributes the station lighting.

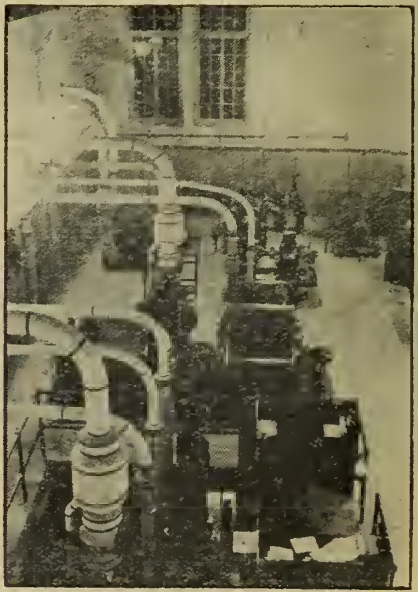


Fig. 4. View looking towards motor Pumps.

The vertical pumps at the intake are both operated from the switchboard, one by the standard hand operated starter and the other by an automatic patent started controlled by a float switch which can maintain a predetermined height of water in the suction well of the main pump.

Behind and above the switchboard and in a closely locked room is the high voltage apparatus for the Barriere incoming lines. The transformers which will change the voltage from 44,000 to 2,200 volts, will, when purchased, be handled on their own trucks and will sit over the necessary oil and water piping. The most approved type of automatic voltage regulator will maintain constant voltage regardless of load variation and this will insure a satisfactory lighting system.

The entire station has been laid out with a view towards utmost reliability and also ease of future extension with a minimum of cost and interruption of service. The machinery and all inter-connecting apparatus is equal to the best that money could buy and no pains have been spared to give the city of Kamloops a plant second to none in the country.

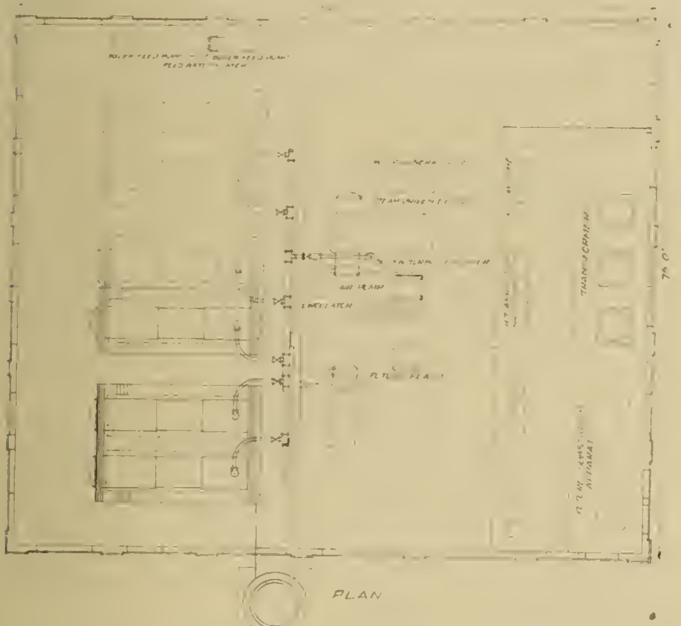


Fig. 5 Plan of steam plant—Kamloops, B.C.

Auxiliary Pump House

The auxiliary pump house at the river is a reinforced concrete well or tank, with a motor room above. The motors are of the vertical type and are connected by long shafts to the pumps located near the bottom of the well, which is about three feet below the lowest water mark of the river. There is about 24 feet maximum variation of the river level, however, and this required careful design of the well to consider an upward pressure in the event of the intake gates being closed during high water flow of the river.

City Distribution System

Both water main and electric lines are brought from the power house underground through the concrete tunnel under the railway track, the electric lines being then carried up a tower in conduit and there distributed. The plant was placed in service on October 28th, and its operation for the requirements of the city service has been very satisfactory. The construction of the power plant and reservoir was carried through to completion with remarkable smoothness and efficiency, due, in a great measure, to the co-operation of all concerned toward making the work a complete success.

Halifax Installs Magnetites

During Christmas week the new luminous magnetite arc street lighting equipment was placed in commission in the city of Halifax, N.S. The old system of street lighting in Halifax consisted of the old style arc but a contract was recently entered into between the Halifax Electric Tramway Company and the merchants along the principal street under which the company agreed to install the new lamps, the extra cost of maintainence being borne by the merchants. This contract is for five years. The cost of the old style of lamp was $62.50 per lamp per annum and the cost of the new lamp is $96 each per annum for an all night, every night, service.

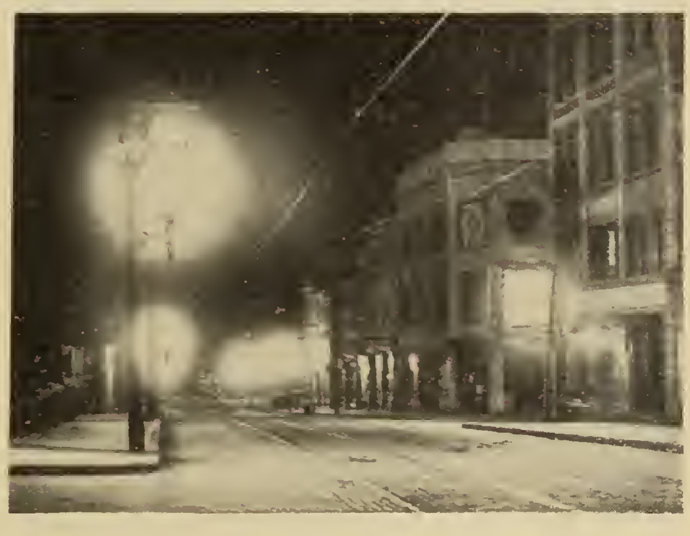


Fig. 1. Halifax main street, by night.

The magnetite lamps are operated by a 50-light mercury rectifier, though at present only 28 lamps are installed. As may be seen from the accompanying illustration these lamps are mounted on ornamental brackets and attached to the trolley poles. The lamps are spaced 110 feet apart on alternate sides of the street.

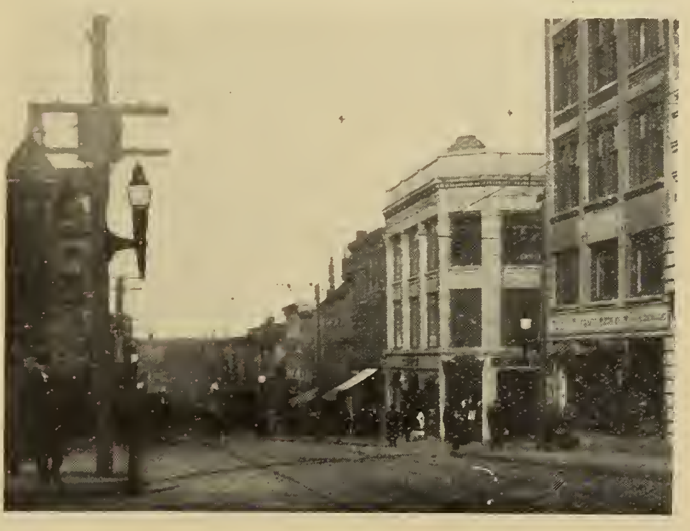


Fig. 2. Halifax by day, showing bracket design.

The inauguration of the system was made the occasion of a considerable demonstration on the part of the citizens. A procession was formed accompanied by the local bands, and paraded the area to be lighted until at a predetermined moment Mayor Bligh closed the switch which lighted the new system and at the same instant cut out the old type of lighting. The contrast was exceedingly gratifying, and the progressive merchants who undertook to bear the added expense of the new system are indeed to be congratulated on the success of their enterprise.

The equipment including lamps, brackets and rectifiers was all supplied by the C. G. E. Company.

Electric Luxury in Transatlantics

The varied application of electric drive and the refinements and luxury of electric control are nowhere better exemplified than in the magnificent new, twin, quadruple screw, passenger steamers, the Alsatian and Calgarian, of the Allan Line Steamship Company, on of which, the Alsatian, left Liverpool for Halifax on January 17 on her maiden voyage. These ships are now the largest in Canada's trade, being 600 feet in length, 72 feet wide, 28 ft. 6 in. draught, and 18,000 gross tonnage. There are eight decks, 11 watertight bulkheads and a passenger capacity, including officers and crew, of 2,350 persons. The power of the driving engines is 20,000 h.p. and the speed attained on trial, fully loaded, was 19 knots.

To supply the needs and comforts of this good sized isolated town, electrical equipment in all its modern phases of usefulness and refinement has been called into requisition. There are electric elevators, telephones, electric fire alarms, ample illumination, signal systems, ventilation and numerous machines for various purposes all operated by electricity, so that it will almost be possible for a passenger to forget that he is not spending a few days in one of the largest and most luxuriant hotels on the American continent. A brief description of the electric installation in one of these duplicate ships is given herewith.

The main electrical generating plant consists of three steam turbine driven sets constructed by the British Westinghouse Electrical Company each capable of giving a continuous output of 250 kilowatts at a pressure of 220 volts when running 3,000 revolutions per minute. The turbines of the main generating sets are of the Westinghouse impulse type, the normal stem pressure being 150 pounds per square inch, exhausting against a back pressure of twelve pounds gauge. A small emergency turbo-generator is also provided and placed in a separate compartment on lower promenade "C" deck well above the load water line of the vessel. This emergency set is also manufactured by the British Westinghouse Company and is of twenty kilowatt capacity at 110 volts.

The main generators are placed on an elevated platform on the port side of the engine room aft, and the main switchboard abaft of the machines on the bulkhead. The switchboard contains the three dynamo panels fitted with automatic circuits of massive design, voltmeters and ammeters of the moving coil type and shunt regulators for each dynamo, there being in all thirty circuit breakers and fourteen switches and fuses.

Three-wire Distribution

A special feature of the installation is the three-wire system which is now fitted for the first time on a large passenger ship. All heavy power circuits are fed direct from the main switchboard at 220 volts pressure, the lighter and smaller motors being supplied from either side of the three-wire supply at 110 volts. From the switchboard heavy lead covered cables are run on the port and starboard side to auxiliary switchboards placed in different compartments and interconnected by heavy cables through circuit breakers forming complete ring mains round the ship, these being so arranged that in the event of a failure on any cable a full supply is still obtained through the opposite feeders. Special precaution against heating has been made by carrying all feeders clear of the engine and boiler room on the deck above these compartments. The total number of lamps installed throughout the ship is about 3,000, all of these being metal filament type. Cables are also run from the main switchboard to the emergency dynamo room for supplying a separate emergency circuit, a change-over switch being provided so that in case of accident a sufficient number of lamps can be kept lighted in the engine room, boiler rooms and passenger accommodation; also on the boat deck should the main dynamos be shut down. Power is also available from this emergency dynamo for working the wireless installation and navigation lights.

Telephone instruments are fitted throughout the suite and special staterooms and connected through a central exchange situated on the main deck and in addition a system of inter-communication telephones between the officers' cabins and also a similar system in the stewards' department.

A complete installation of electric clocks of the magneto type is fitted in the public rooms, entrances and chart room controlled by a master clock.

Automatic fire alarms are fitted throughout the vessel with an indicator in the navigating room. Thermostats, or heat detectors are fixed in the different compartments. These can be set so as to give an alarm at a rise of 15 degrees Fahrenheit, and can be limited for compensation to any predetermined temperature; means are also provided to allow each circuit to be tested for continuity by pressing a button at the indicator.

In addition to the above a very complete system of fire alarm pushes and bells are fitted in corridors, etc., these being connected to indicators in the engine room and navigating bridge.

For the navigation of the ship Graham's loud speaking telephones are fitted on the navigation bridge, communicating between forecastle, crow's nest, docking bridge aft and chief engineer, Marconi room and bow.

Submarine Signals

A complete system of submarine signalling apparatus is fitted in the ship and also a semaphore with Morse flashing lamps and keys on a platform above the bridge.

Bell communication is fitted to every part of the ship with indicators in the different service rooms, buzzers being used in place of bells to guard against unnecessary noise in the vicinity of the cabins.

A navigation light indicator of McGeoch's new pattern is fitted for masthead lights, bow lights, anchor and stern lights.

A complete system of Stone-Lloyd watertight door signals has been fitted, each connected electrically to an indicator situated in the navigating cabin. This indicator consists of a watertight case containing an aluminium face with plan of the ship engraved thereon and having circular openings with ruby glass discs corresponding to the number and position of the doors and each illuminated by a separate lamp which indicates on the closing of the doors.

For the ventilation of the ship an elaborate system of hot and cold air apparatus is fitted, the whole of the fans for this installation being electrically driven. Forty-six motors are fitted which require over 150 horse-power.

Four large forced draught fans for boiler rooms, are provided and twelve ventilating fans for stokeholds and engine rooms, the total horse-power of these being 250.

Turbine lifting and turning motors, three in number, are provided of fifteen horse-power total capacity.

In galleys, electrical power is used for the bakery machine, cooking ovens, with motor driven spits, knife cleaners, dish washers, potato peelers and freezing machines, and a large number of electric hot plates are fitted throughout the dining saloons and bars for keeping food and liquids warm during service; this gear requires about sixty horse-power.

The gymnasium is equipped with motor driven appliances consisting of one frictional machine, one Seiste's machine and three horse exercise machines.

Curling tongs, heaters and fans are fitted in first class cabins, also wing fans in the public rooms.

A motor driven printing machine is also placed in the printing room.

The barbers' shops are provided with the latest type of electrically driven hair brushes, hair dryers and massage apparatus; each machine is fed from a socket placed in convenient position to the chair, no overhead shafting being required.

The steam whistle is worked by a small motor and solenoid enclosed in a watertight case placed in a convenient position near the whistle. Provision is made for blowing by hand cord in the ordinary way and the whistle can be operated by the three switches placed port, starboard and amidships on the Captain's bridge; these are so arranged that either "time control" or "signal control" can be made by turning to the right or left.

A Waygood Passenger Elevator is fitted in the centre of main stairway on first class accommodation, passing through five decks, two mail and baggage lifts and also two lifts for the provision chambers, the total power required for these lifts amounting to about ninety horse-power.

The Telephone Year in B. C.

One million dollars was the approximate cost of improvements made by the British Columbia Telephone Company during the year 1913. These improvements were not confined to any one district, but included work in the territory of practically every exchange the company operates, from the west coast of Vancouver Island to the eastern extremity of the Lower Mainland, at Kamloops in the middle interior, and in the Kootenay and Boundary districts. The principal piece of construction was the laying of the direct submarine cable to Vancouver Island from Point Grey on the mainland, details of which have already been given in these columns.

In its aim to establish a complete system the company laid out a general scheme of construction, and after several years of steady progress it has now the general lines of its plan filled out. While working with the object of meeting present demands, the company have also been obliged to provide for the future, and they are now so situated that additional service may be supplied at short notice.

Though a considerable amount of money has been spent during the past year, there was no single item, apart from the cable construction mentioned, that might be termed large. In Victoria, extensions to outside plants were comprehensive, these consisting of the erection of poles and stringing cable. A heavy amount of block work has also been under way there for some time past. In the district north of Victoria notable progress has been made in the re-routing of the longdistance line extending northwards. This line formerly ran over the Sooke mountains, and winter storms often interrupted service. Two new copper circuits have been constructed between Victoria and Nanaimo, with a short piece of submarine cable across Saanich Inlet. The toll lead now goes via this circuit, which should ensure continuous service. North of Nanaimo, a long distance lead was built to Parksville, and as the line from Cumberland and the Comox district runs via Parksville, an improvement was effected in the whole service on the eastern coast of the island. With the present facilities perfect telephonic communication has been established between any point on the lower mainland of British Columbia and any point on Vancouver Island. In and about Vancouver lines have been extended to suburban sections which were built up during 1911 and 1912. The largest estimate was in the Point Grey district, out of the Eburne exchange, where every applicant has been taken care of, several thousand feet of aerial cable being strung throughout the district.

A new long distance lead is now in course of construction between Vancouver and New Westminster, with better connection up and down the Fraser Valley. In New Westminster several large estimates were carried out. In Port Coquitlam a new exchange was cut over on January 13th, 1914, and in connection therewith considerable outside construction took place. At no point has progress been more noteworthy than at Kamloops. This town has experienced considerable expansion during the past year due to the large amount of railway construction which is under way in the district, and the telephone company has completed two large estimates there.

Improvements to pole lines provided the chief feature in the cities of the south-eastern part of the province, the principle work carried out recently being the changing of the system at New Denver, which included Silverton, from the old grounded system to the metallic system. In addition to this work the lead between New Denver and Silverton was shortened.

During the past few months the company's engineers have been engaged on the work of improving the transmission of the cable to Victoria via the Gulf Islands. This cable runs south from New Westminster to Bellingham thence by way of Lummi, Orcas and San Juan islands to Vancouver Island. Repeating coils have been installed with marked results, and further experiments are being made in the hope that even better transmission can be secured. This cable carries traffic from the lower Farser Valley to Victoria, and also from Washington state points, and forms an important connection.

It is to work of the nature stated above that the B. C. Telephone Company are giving the most attention now that its system, taken as a whole, is fairly complete. In persuance of their comprehensive scheme of construction the company have expended upwards of seven million dollars. The aim of this general constructional programme has been not only to keep thoroughly up-to-date in point of equipment, but also to have it sufficient to meet demands for a reasonable period in the future. That being the case, the company, while their system is not over-built, are well supplied with facilities and are in a position to take care of growth as it arises.

The past year also proved an active period as far as the erection of buildings was concerned. The company own their own building in nearly every district in which they operate. During 1913 new exchanges were erected at Fraser, a suburb of Vancouver, and at Port Coquitlam, and a suitable building was acquired at Greenwood. A six-storey plant headquarters was erected at Vancouver, and work inaugurated on the new eight-storey central office building on Seymour street, Vancouver, in which provision will be made for three exchanges. The steel frame work of this building is approaching completion, and the work of erecting the concrete basement was under way before the end of January.

Many New Companies

The following rural telephone companies have been incorporated:—Heron Rural Telephone Company, Limited, Heron, Sask.; Huron Rural Telephone Company, Limited, Tugaska, Sask.; Hanson Rural Telephone Company, Limited, Lajord, Sask.; Downing Rural Telephone Company, Limited, Lajord, Sask.; Hill Crest Rural Telephone Company, Limited, Bladworth, Sask.; Bonnie View Rural Telephone Company, Limited, Loreburn, Sask.; Ellsworth Rural Telephone Company, Limited, Macoun, Sask.; Hildahl Rural Telephone Company, Limited, Estevan, Sask.; High Ridge Rural Telephone Company, Limited, Kennedy, Sask.; Pleasant Valley Rural Telephone Company, Limited, Bladworth, Sask.; Rugg Rural Telephone Company, Limited, Outram, Sask.; Star Rural Telephone Company, Limited, Antler, Sask.

Electric Railways

New Cars for Montreal Tramways

In pursuance of their policy of providing additional facilities, the Montreal Tramways Company have placed a large number of new cars on the streets and also intend to operate many more, deliveries being made at the rate of from four to six per week. New routes will, however, be required to bring the entire rolling stock into use. The cars are of a new design, manufactured by the Canadian Car and Foundry Company at Turcot, just outside Montreal.

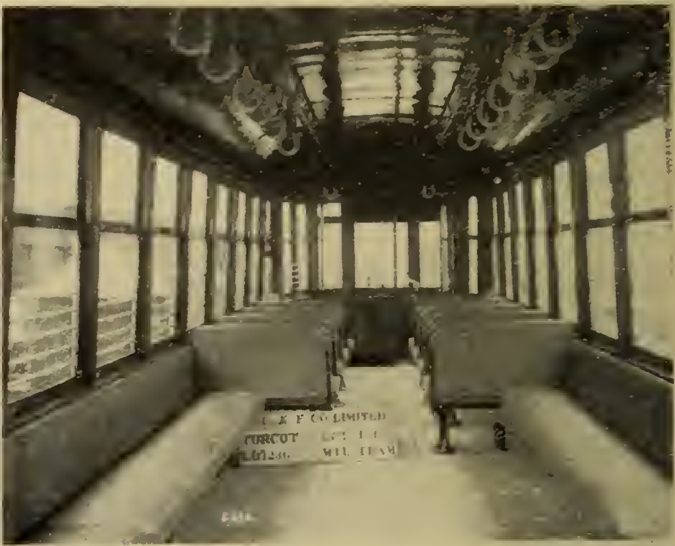
The underframe for the new design of car is composed of steel throughout, with 1-5 in. x 18 in. O. H. steel plate side girder running the full length of the car. Keystone corrugated galvanized steel plate, No. 22 gauge, is secured to the underframe which supports the composition flooring $^3/_8$ in. thick at the thinnest point, which in turn is covered with 3-16 in. thick rubber tiling.

The platforms are supported by open truss knees, which are rivetted to side sills and suspended from the body and sill by bolts, making the platform detachable, facilitating repairs. The usual railings used on "pay-as-you-enter" platforms are provided, with the addition of one located on the rear step for dividing incoming and outgoing passengers. The front platform is separated from the body by two pipe stanchions, and exit is afforded through a folding door operated by the motorman.

New street cars for the Montreal Tramways Co.

The car is fitted with the plain arch roof, which has been adopted by the Tramways Company as their standard design in place of the monitor roof, its light weight, simple construction, strength and adaptability to exhaust ventilation being much more satisfactory.

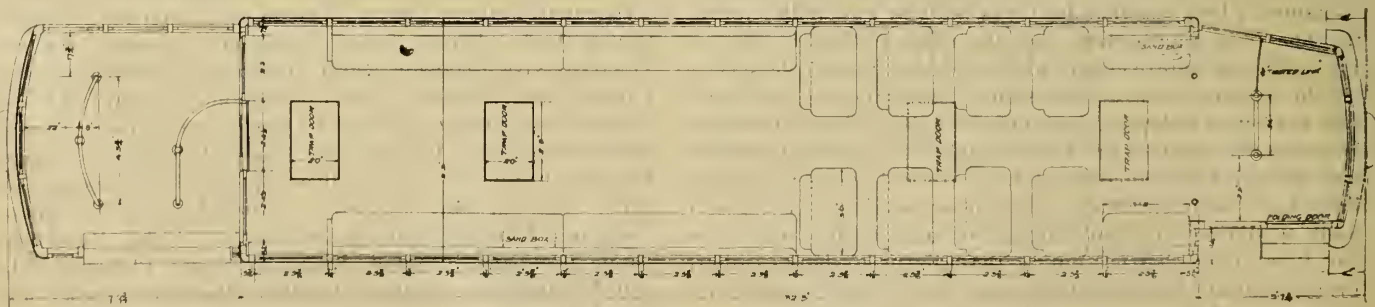
The seating accommodation, which provides for 44 passengers, consists of two longitudinal seats at the rear for 12 passengers each, and 10 Brill stationary back cross seats at the forward end seating 20 persons. All windows are arranged with double sash, top sash stationary and bottom to raise. The interior is finished in cherry, and sanitary hand straps are provided above the longitudinal seats.



Interior new standard Montreal car.

The general dimensions are: length over body 32 ft. 3 in.; length over platform, 45 ft. 8½in.; width over side sills, 8 ft. 2½ in.; height from rail to top of car, 11 ft. 4 in.; and height from floor to centre of headlining, 7 ft. 7 in. The weight of the body and truck, exclusive of electric equipment, air brakes, and heater is 33,000 pounds.

Owing to the type of roof, a new system of ventilation—the Garland exhaust—has been fitted. Electric heating is pro-



Plan of car now being standardized by the Montreal Tramways Co.

vided; the air is drawn through pipes under the seats, directly heated on entering the car and passes out through openings in the roof.

The motor equipment includes four motors of the 533 F 4 type, a K 35 G controller, rheostat, circuit breaker and lightning arrester, all supplied by the Canadian Westinghouse Company. The air brakes are Canadian Westinghouse D 1 E G straight air equipment and Canadian General Electric C P 27 straight air.

A new design in front signs is also fitted. These are lighted by two 62 volt, 40 watt tungsten lamps in series with four 110 volt, 16 c.p. carbon lamps. All wires run in conduits.

The truck scrapers are of a new type, designed by Mr. Blair, superintendent of rolling stock.

As explained in a previous issue of the Electrical News this type of car will be operated in pairs, the trailer being almost identically the same as the motor car, only reversed, so that the two ends containing the horizontal seats are together. Twenty-five of these two-car trains are at present under construction.

Rear platform, p a.y.e. construction—Montreal.

Locomotive Operating Costs

The Galt, Preston & Hespeler Railway Company, Limited, placed a 40-ton Baldwin-Westinghouse locomotive in service on November 30th, 1910, which since that date has been in continuous operation, twenty-four hours every day except Sundays, averaging about 150 hours per week. This service includes hauling practically every kind of freight in standard steam railroad rolling stock, between the Canadian Pacific Railroad at Galt, Berlin and Waterloo, a distance of from 12 to 14 miles north.

Although the haul is not so very long there are a number of 2 to 2½ per cent. grades, from one to two miles long. The maximum number of cars hauled in one train is about 25, the average number being 15, and the tonnage per train is about 200 tons or on four trips of road service per day about 2,000 tons. It is hardly possible to estimate exactly the total mileage as the greater part of the time, 16 hours per day, the locomotive is in switching service. No record is kept of the tonnage and mileage, but the switching mileage would easily equal half, if not three-quarters, of the road service. This locomotive is equipped with four Westinghouse No. 308-B-2 commutating-pole, 600-volt, railway motors, rated at 120 h.p., and unit switch control.

The locomotive is given one-half hour inspection every twenty-four hours, and about five or six hours every Sunday, when making light repairs, such as applying brake shoes, changing wheels for tire running and inspection of motors, air-brakes, and control equipment. Tires have been turned twice since this locomotive went into service and the total repair amount to date is given below:

Air compressor (principally due to armature and field trouble due to low trolley voltage)	$170.00
Tire turning	15.00
Motor axle bearings	30.00
Unit switch control	50.00
Trolley parts, wheels, harps, poles and bases	110.00
Brake shoes	270.00
Miscellaneous	30.00
Total (from Nov. 30, 1910, to July 14, 1913-	$705.00

The total of $705.00 for repairs on this locomotive, covering a period of over two and a half years, is considered a very good record by the operating company in view of the large amount of service received.

The Effects of Rate of Fare on Riding Habit

By Mr. F. W. Hild, Gen. Mgr., Portland Railway, Light & Power Company.

In this paper, instead of placing rates first, Mr. Hild puts safety first, service second and rates last, as representing the logical order in which public service corporations should be approached. The author advances statistics shown diagrammatically in Fig. 1 as proof of his contention. Fig. 1 shows the riding habits of a number of American and British cities having populations greater than 150,000 about which the paper says:—

"It is quite clear from the chart that a low rate of fare is by no means the important determining factor in the creation of the riding habit. If it were, we should naturally expect to find the British cities with their smaller zone charges heading the list, while in the United States we would look for Cleveland, the champion low-fare city, at the top of the list, with Toledo next and Columbus, Toronto, Indianapolis, Milwaukee and other reduced-fare cities ranking close behind. As a matter of fact, the riding habit is seen to be greater in cities having straight 5-cent fare (Seattle's twenty-five tickets for $1 do not carry transfer privilege). Cleveland is about midway and Toledo near the bottom of this list of American cities, where the British cities, despite the lower charges per ride, are far below American cities in the extent of street car patronage."

Factors Favoring the Riding Habit

In the judgment of the writer, the riding habit or the street car patronage by the people of a city depends upon:

"(1) Facilities.—Without facilities there can, of course, be no street car patronage. On the other hand, the more and better facilities, the greater the incentive to ride. The amount of trackage per capita and the number of cars operated per capita are probably the fairest measure of street car facilities in cities which have no rapid transit system like subways and elevated railways. In this respect the Pacific Coast cities lead the world, and this is reflected in the high degree of patronage they enjoy. In like manner, the rapid transit facilities of New York encourage the high riding habit of that city. This is strinkingly brought out in Fig. 2.

(2) Topographical Conditions.—People living in hilly cities will naturally ride more frequently than those in flat, level cities. Thus we should expect to find cities like San

Francisco, Kansas City, Seattle and Pittsburgh show a high riding habit.

(3) Climatic Conditions.—Cities enjoying a great deal of sunshine and clear weather invariably show a higher street car patronage than cities where climatic and weather conditions are less favorable. During the bright, pleasant days people will come out for purposes of pleasure and convenience as well as business. In other weather they come out only of necessity. This is proved by the experience of each city considered by itself in connection with the seasonal fluctuation of travel. Los Angeles, New York and tropical cities like Havana have favorable climatic conditions, and the effect is shown in the street car business. Such cities generally attract a relatively large floating population, which, of course, helps out in the street car patronage.

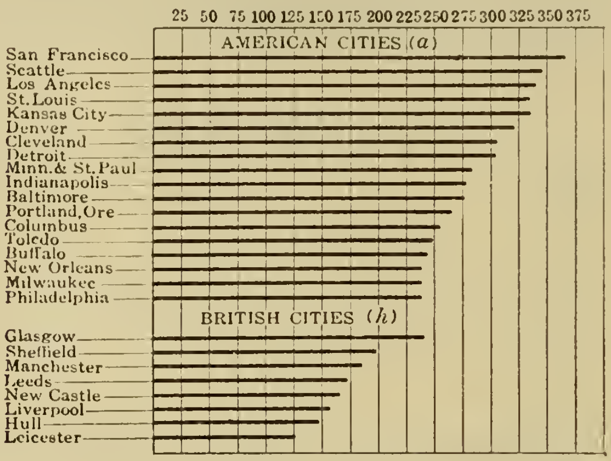


Fig. 1.—Riding habit—Annual revenue rides per capita.

(4) Temperamental Characteristics.—A pleasure-loving people are usually liberal spenders, and they generally patronize the cars quite freely, as in Havana. People in mining communities are known everywhere to be more liberal spenders than those in agricultural or mercantile communities. Cities which originated in the mining camps seem to have perpetuated these proclivities, and this characteristic is reflected in the riding habit. Thus one would expect San Francisco, Denver, Seattle and Pittsburgh to rank high in this respect.

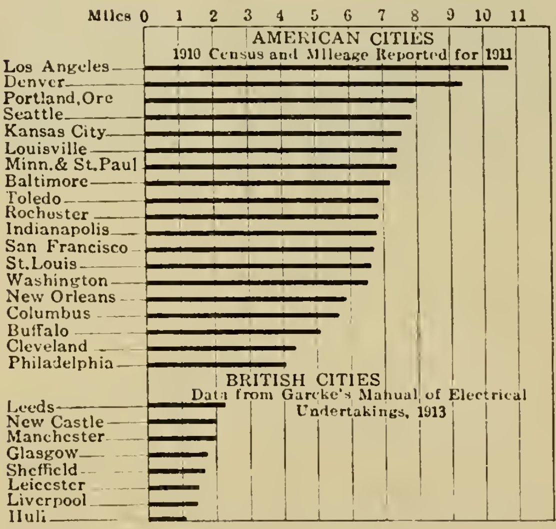


Fig. 2.—Miles single track for 10,000 inhabitants.

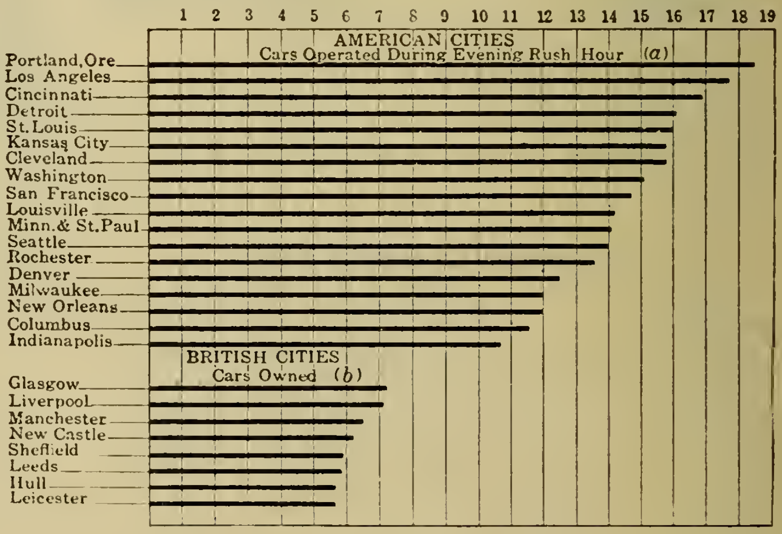


Fig. 3.—Cars operated during Evening rush hours.

(5) Rates of Fare.—At the rates of fare which now prevail, changes in rate, unless very radical, will have the least effect of all the factors which determine street car patronage. If fares were abolished and transportation were free, the riding would, of course, vastly increase, while, on the other hand, if the present fares were doubled or otherwise very radically increased, the riding would naturally fall off. All this assumes that the facilities for urban transportation remain about the same. Increase of facilities, either in the form of greater comfort or in more widespread, quicker or added service, may stimulate enough travel from another group of patrons to counterbalance that lost by the higher charges. Thus, when the New York surface lines were separated under receivership proceedings, the transfer privileges were materially cut down, but the decrease in number of riders, if any, was more than made up by the patronage of the subways, for, as shown in Fig. 2, the points of the curve of riding for New York have constantly increased. A further demonstration of the principle is the liberal patronage created by the Pullman service of the railroads and the popularity of many extra-fare trains."

The author expresses his opinion that in the long run you get exactly what you pay for whether you buy street railway rides or any other commodity and on this point Mr. Hild expresses himself as follows:—

"Lower prices stimulate business" as a business maxim has an important corollary which is sometimes expressed: "In the long run you get exactly what you pay for, no more, no less." Thus good prices justify the expectation of fair goods and liberal service, while "cheap prices mean cheap goods." The latter maxim, indeed, but exemplifies an important phase of the natural struggle for self-preservation which is a law of business as well as of nature.

In the street railway field the operation of this corollary is significantly shown in the accompanying charts of trackage per capita Fig. 2 and of cars operated per capita Fig. 3, which combined are a fair measure of the investment per capita for street railway purposes. Thus the 5-cent fare cities lead the "reduced" far cities in street car facilities. Cleveland, famous as having the lowest fare in the United States, has since the beginning of the 3-cent car service in 1910 added only 5 miles of track, despite the fact that its average increase of population has been and presumably continues at the rate of about 18,000 per year. Its total of trackage and cars operated per capita rank it below other cities which so far have escaped the fallacy of "reduced fares."

The absence of data as to "cars operated" in the British cities makes it necessary to consider the British "cars owned" in the cities compared. The charts of trackage and cars per capita strikingly bring out the superiority of American cities.

To just what extent low fares or the deadening inertia of municipal ownership is responsible for the marked inferiority of the British systems, in the extent of street car facilities, is difficult to state. But no doubt both contribute to the showing."

The figures herewith are taken from the Electric Railway Journal's presentation of the subject.

Single-Phase to 1200 d.c.

A current issue of the Electric Railway Journal describes a 1200 volt direct current installation which has recently been placed in commission on the Pittsburgh & Butler Street Railway to replace single-phase operation at 6600 volts. The article states that this equipment should be of interest as it is the fifth single-phase interurban road in the United States which has substituted 1200 volt d.c. for single-phase equipment.

Transmission is now by 3-phase, 22,000 volts, the original single-phase line being utilized by the addition of a third wire. Two sub-stations, respectively 10.12 and 26.44 miles from the generating station, each contain a 300 kva., 25-cycle, 1200 volt synchronous converter and a 300 kv.a., 3-phase, oil-cooled transformer, 22,000/740 volts, and the necessary switchboard with feeder and starting panels. The incoming 22,000 volt circuits are protected by aluminium lightning arresters. Choke coils, disconnecting switches, and oil switches are also installed.

The synchronous converters are rated at 300 kw. at 750 r.p.m. and are provided with the usual end-play, speed limit and brush raising devices. These machines are capable of handling 50 per cent. over-load for two hours, and three times normal load momentarily. A separate panel is used for starting from the a.c. side.

There are three grades on this road averaging from 7 per cent. to 9 per cent., but it is stated that the original schedule has been improved and speeds as high as 48 miles per hour are common with a maximum of 60 miles on favorable grades.

Figures given show that a reduction in power consumption per car mile of not less than 15 per cent. has been shown for corresponding periods and in addition the mechanical and electrical force at the car house has been reduced 54 per cent. compared with that employed a year ago. The total length of road operated at 1200 volts is about 28 miles.

Anxious for Radials

Some 150 representatives from Berlin, Waterloo and the counties of Waterloo and Oxford recently assembled in Berlin and discussed the hydro-radial question. The following resolution was unanimously passed.

"Moved by Mayor W. S. Hobson, seconded by J. G. Reiner, That the municipal councils of Woodstock, Berlin, Waterloo and Wilmot, Bleinheim, Blandford, East Zorra, Wellesly and Woolwich townships be requested to make an immediate application to the Lieutenant-Governor-in-Council to investigate as to the advisability of constructing electric railway lines under the auspices of the Hydro-electric Power Commission of Ontario, as follows:

Berlin to Woodstock, serving the following points—Mannheim, New Dundee, Washington, Plattsville, Bright and Innerskip.

Berlin-Wellesly, serving Waterloo, Heidelberg, St. Clements, Hawkesville, Linwood, Cross Hill, Wellesly, Barberg and St. Agatha.

Berlin to points in Woodwich Township, serving Bloomingdale, Connestogo, Winterbourne, West Montrose, New Germany, Elmira and Floradale, and that the immediate committee be appointed to urge upon their respective councils the immediate passing and forwarding of such resolutions."

16,000 Volt, Single-Phase Line

A single-phase railway line has recently been placed in commission between Vienna and Pressburg, Hungary, which operates at 16,000 volts single-phase. On the locomotives the voltage is stepped down from 16,000 volts to 600 volts a.c. for use by single-phase commutator motors. Both passenger and freight locomotives are rated at 750 h.p., the former travelling at a little less than 50 miles and the freight at 25 miles per hour. Pantagraph collectors are used in each case.

Personal

Mr. W. K. Stalford has been appointed electrical inspector for the city of Hamilton.

Mr. H. D. Bayne has severed his connection with the Canadian General Electric Company. Mr. Bayne has held a prominent position with this company for a number of years as special agent.

Mr. Hugh L. Cooper, chief engineer of the Mississippi River Power Company during construction work, has opened an office at 101 Park Ave., New York City, to engage in the practice of general hydraulic engineering.

Mr. H. Doughty, superintendent of the Regina municipal railway system was recently presented with a handsome loving cup by the members of the Street Railway Mens' Union of Regina. This may be taken as indicating the spirit of co-operation and good feeling that exists between the officials and the men of that system.

Mr. Julian C. Smith, manager and chief engineer of the Shawinigan Water and Power Company, Montreal, has been awarded the Gzowski medal by the Canadian Society of Civil Engineers for his paper on "High Voltage Transmission Lines." This paper was reproduced, at the time of its presentation, in the Electrical News

Mr. Goodwin Shenton.

Mr. Goodwin Shenton has been appointed manager of the Winnipeg, Vancouver and Victoria branches of John Millen & Son, Montreal. Mr. Shenton is a native of Winchester, England, and was educated at the Peter Symonds School, Winchester, and at Hartley University. He was articled to the late Dougal Drummond, of the London & South Western Railway, and spent six years in the works and designing offices of that company. Coming to Canada in 1911 he joined the railway supply department of John Millen & Son, latterly acting as assistant to Mr. F. D. Lyman, the manager of the department. He has now been appointed to their Western branches and has taken up his duties there.

The Development of Wireless

A paper on the history and development of wireless telegraphy was read by Mr. A. E. Reoch, secretary-treasurer of the Marconi Telegraph Company of Canada, Limited, at the meeting of the Montreal Electrical Society on February 2. Mr. Reoch, who is an authority on the technical side of wireless, described the experiments which resulted in the present apparatus, and the methods of transmission and receiving. He also described the system of duplex wireless telegraphy, and how various difficulties had been successfully overcome by Mr. Marconi.

Illumination

Ornamental Street Lighting, Peterboro, Ont.

By Mr. L. Burpee

The tendency which has been so widespread during the last two years towards the use in street lighting of Canadian General Electric ornamental luminous arc lamps, placed at frequent intervals has been inspired primarily by an ever increasing appreciation of the value, when viewed from every angle, of intensive or ornamental lighting for business and principal residential sections. A survey of the movement indicates that credit must be given first to those merchants who showed their faith in the new lamp by making arrangements for its installation, that is, by agreeing to pay installation and operating charges on a foot frontage basis. So eminently satisfactory did the new lamp prove that in the last two years over 10,000 have been installed in the different cities of Canada and the United States. In Canada during the last year installations were completed at Calgary, Edmonton, Winnipeg, Westmount, Halifax, Lindsay and Peterboro, though at none of these places, perhaps, was more jubilation indulged in, when the new system was put into commission, than at the last named place. Here the old well-known open arc lamps, installed at about 25 feet above the roadway on mast arms secured to wood poles at street intersections, had held the field alone for many years.

The work of installing the new equipments had been pushed forward to completion and the system put into working condition and inspected in every detail before it was finally announced that it would be inaugurated by Mayor Bradburn at 8 o'clock Wednesday evening, December 17th. The mayor and the city council, shortly before the hour appointed, drove to the city hall, where they were met by crowds of interested citizens. Two brass bands, to show their appreciation of the city's undertaking, offered their services and furnished appropriate music. His Worship began to address the multitude by the dim light of the old system shown in photograph, Fig. 1, but in the midst of his remarks and just as the great clock overhead sounded the last stroke of eight, the one hundred ornamental luminous arc lamps burst forth in magnificent brilliancy, changing the streets from darkness to comparative daylight, amid cheers and expressions of surprise and approval. Mayor Bradburn concluded his remarks with, "Ladies and gentlemen, there is the best lighted street in the Dominion of Canada, and that is saying a good deal" (see photograph, Fig. 2), and called upon alderman Johnston, who was chairman of the lighting committee, to address the citizens. At the conclusion of alderman Johnston's remarks, a procession, headed by the bands, formed and proceeded along George street, the principal thoroughfare of Peterboro, and ended with a second round of cheering at the sub-station, where the council made an inspection of the station equipment. Details of the installation are as follows:

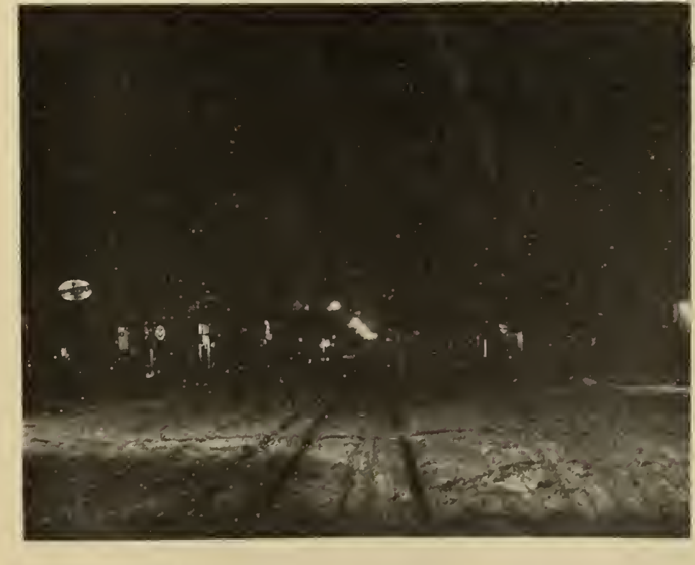


Fig. 1—George St., Peterboro, midnight. Taken from same point as Fig. 2, same exposure, 5 min. Old open arc lamp system. Night dark and rainy.

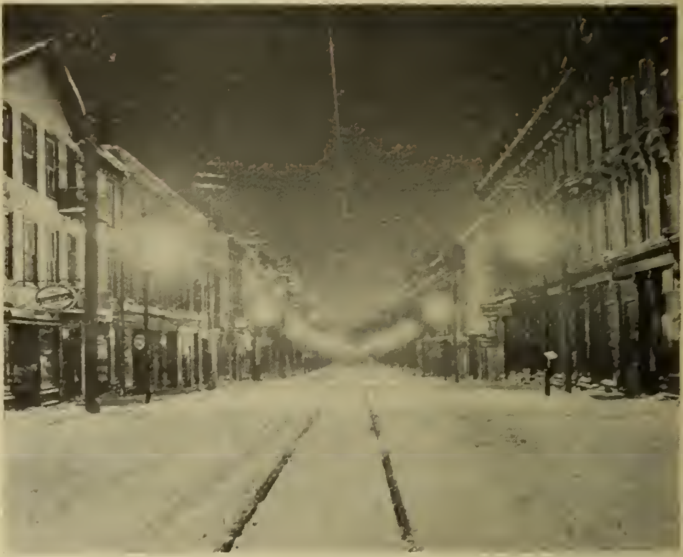


Fig. 2—George St., Peterboro, midnight. Taken from same point as Fig. 1, same exposure, 5 min. New magnetite arc lamps. Night dark and rainy.

Cable

The installation consists of 19,500 feet of No. 6 B & S. solid, tinned copper conductor with 6/32-in. N. E. C. rubber and tape insulation, and with 7/64-in. lead sheath and double steel tape armor. There is a jute bedding between lead and sheath and also a jute winding over the armor. Net weight of cable was 43,500 lbs. It was tested at 10,000 volts a.c. for ten minutes. The cable is buried in the ground 24 inches below the surface of the sidewalk. The trench dug in laying it was 14 in. wide and 18 in. deep. The cable enters the iron poles through 2-in. wrought iron bends laid in concrete. The lead sheathing is bonded at each lamp insertion.

The armor at each insertion is soldered to the lead sheath and is also grounded at every third lamp.

Poles

There are eighty-six combination trolley and light poles placed opposite on both sides of the street on 115 ft. centers. They are set with a 6-in. rake and are placed 5 ft. 3 in. in the ground on a 3-in. cement bottom to prevent sinking. Holes 18 inches in diameter were filled with concrete, using one and one-half bags of cement per pole. The total length of pole is 28 ft., made up of three sections of wrought iron pipe. The streets are 42 ft. wide between curbs. The centers of the poles are 10 inches from the curb so that the distance between arcs of opposite lamps, when mounted on the ornamental brackets, is about 40 feet. Each post has an ornamental base 16 inches square at the bottom, 8 inches square at the top and 41 inches high. The lamps are placed so that the arcs are 16 feet above the sidewalk. At the railway crossings the poles increase in length, stepping from 28 ft. up to 32 ft. and then up to 35 ft. over all, the latter being 7 inches in diameter at the bottom section.

There are fourteen ornamental standards on cross streets having no street railway, spaced 120 ft. apart and placed on both sides. Arcs on these are 14 ft. 6 in. above sidewalk. Lundin cutouts are used throughout, being placed in the brackets on the combination poles and in the bases of the ornamental standards.

Station equipment

The station equipment consists of two Canadian General Electric 50-light, 60-cycle, combined unit series mercury arc rectifiers. These receive energy at 2200 volts and first step it up to 14200 volts at the terminals of the constant current transformer secondaries and then rectify it to 6.6 amperes d.c. at 4500 volts. Current is supplied to the load circuit at a constant value of 6.6 amperes, the voltage varying with the number of lamps in series. The current will not vary more than two-tenths of an ampere from normal between full load to one-third load with full load adjustment. An 80 per cent. load tap is provided for use on low loads. The accompanying photographs were taken at the same point at 12 o'clock midnight December 23rd and were given equal exposure. The night was dark and rainy. The old open arc lamps are shown in Fig. 2 hanging much above the ornamental lamps.

Two Circuits

There are two independent circuits, one from either rectifier equipment, with lamps so connected that all the lamps on the west side of George street and those on the north side of cross streets are in one circuit while those on the east side of the former and on the south of the latter, are in the other. By this arrangement, one circuit can be cut out at midnight and yet leave the streets well lighted. To obtain even burning of electrodes, the circuits are cut out alternately.

Installation of the Peterboro system was made by Mr. J. H. Greer under the direction of Mr. R. J. Jeffrey of the Hydro-electric Power Commission of Ontario.

Factory Lighting

By G. H. Stickney

The economic value of good illumination, aside from accident prevention, is evident in the greater facility with which an employee can work under good illumination and the greater accuracy with which gauges can be read and tools can be set. One large manufacturer, on investigating his lighting conditions, found certain departments in which the operatives were practically idle for about an hour a day during the winter months, solely on account of darkness. Good artificial illumination can be furnished in such a factory for eight hours a day at a cost equivalent to about five minutes of the time of the workmen benefited. This illustrates the extravagance of poor lighting. For a great variety of conditions good illumination reduces the manufacturing cost by increasing production, raising the quality of workmanship and reducing the number of defective parts and "seconds."

Accident Prevention

The phase of accident prevention is illustrated in the case of the foundry or other shop where cranes or other powerful machinery are in operation. The likelihood of crane and elevator accidents is greatly reduced with proper lighting. In the foundries and yards of a plant it is practically impossible to eliminate irregularities under foot. If not illuminated, these may readily cause falls, with resulting injuries; and in foundries where molten metal is carried and hot metal abounds they may often cause serious burns. Even though guarded to the fullest extent, powerful machinery presents a menace unless the operatives are given an opportunity to see and thus avoid the danger points.

As to the preservation of the eyesight, there are many manufacturing operations which cannot be carried on without accurate visual inspection. Some of these produce considerable strain even under good illumination, and to require their performance under poor illumination is certain to result in more or less rapid impairment of vision.

Undoubtedly a higher intensity of illumination is needed in most workrooms, but there are other features of equal and sometimes greater importance. The minimum intensity acceptable generally depends upon the reflecting power of the surfaces to be seen, the fineness of the detail to be observed, the time of observation and the closeness of application. Unless glare be introduced, a higher intensity of light is rarely objectionable, except from the standpoint of cost. The gain secured by the increase of intensity is not proportional to the intensity, and there is a point beyond which the gain would not warrant the additional cost.

The most common defect in lighting is excessive glare and absence of diffusion. Glare may emanate directly from the light source or be reflected to the eye by a glossy surface; it can also be caused wherever excessive contract of intensity appears in adjacent fields of vision. The dazzling effect is unpleasant and interferes with seeing. Under continued exposure eyestrain and even permanent injury to the eye may result.

Use of Reflectors

The workman frequently complains of insufficient light when in reality the intensity may be higher than is required for the work. In case an attempt is made to correct this by installing a larger light, the workman's eyes are subjected to a still more severe strain. The proper correction should be to shield the light by means of a proper reflector. As such a reflector would tend to direct more of the light upon the work, the working intensity would be increased; hence in many cases it may be possible to reduce the size of the lamp, or relocate it so as to enlarge the area illuminated.

When a light cannot be removed entirely from the field of vision its brilliancy should be reduced by means of a diffusing globe or reflector so as to increase the apparent size of the light source and reduce the contract between it and the background and the sharpness of shadows in the illumination.

Glare received from specular reflection of glazed paper, desk tops or polished metal often induces eye trouble, headache, and other indispositions, though the sufferers may not be aware of the cause. The remedy is to change the relative positions so that the reflected light is kept out of the eyes as much as possible and to enlarge the dimensions of the light source.

The Dealer and Contractor

The Status of the Electrical Contractor

Did it ever strike you that the most difficult man to locate on a piece of construction work is the electrical contractor? Nobody seems to have heard that name. They will tell you who the architect is, or the general contractor, or the painter, or the brick layer, but the electrical contractor—that is a new one.

Yet it may be safely taken for granted to-day that the installation of electrical equipment in the majority of our buildings is one of the most important features in the appearance, comfort, economy and utility of that building. Why then the difficulty in locating the electrical contractor? The answer seems to lie in two directions. First, the electrical contractor of the past has been a man of no particular standing with no particular knowledge, but has been a graduated wireman at the best. Second, the architect, or possibly the general contractor, has taken it on himself to advise in these matters, a function clearly outside and beyond his territory, both because he has not the necessary knowledge and because the electrical installation does not play any particular part in the general scheme of architecture, artistic or otherwise. We are inclined to think the architect has been much at fault in this respect. In dealing with the owners of buildings he has been dealing with people who know nothing of electrical matters, and who were easily mislead. In the vast majority of cases the architect had no intention of misleading, probably, but his error resulted from the fact that he did not know the scientific possibilities of electrical contracting, and he did not know that he did not know.

With advance in electrical contracting and the appearance in the field of better trained, even scientifically trained, men the status of the electrical contractor has been wonderfully improved and there is now neither reason nor excuse why this work should be handled by anyone else. There are yet however a great many architects who fail to confer with the electrical contractor, regarding the installation of his material, until it is too late. For example, the case of a factory lighting installation was brought to our notice a few days ago where a room 100 ft. square and 12 feet high was being allowed only 9 ceiling outlets. It is greatly to be feared the electrical contractor will be blamed for the poor illumination while the architect will be commended for the handsome appearance of the exterior of the building. Regarding the relation between architects and electrical contractors an interesting paper appears in the current issue of the National Electrical Contractor, by Mr. J. C. Austin, which we reproduce in part:—

"The relations that existed between an architect and an electrical contractor a few years back were very unsatisfactory for several reasons—the first being that most architects did not know the rudiments of electricity, and as a consequence had to rely on the knowledge of the electrical contractor, and generally the one who submitted the lowest bid (owners seldom accept any other). The man submitting the lowest bid is not always an embryonic Edison: very often he is a financial fool who has simply counted up the number of outlets and guessed what it would cost to give a result that would pass the inspection of the architect (who was, as I said before, densely ignorant of the subject) for the smallest amount possible.

After the contract was awarded and the work was started, the contractor's assumed profits began to look microscopically small, so he would then invade some kindergarten and employ labor from that source. He would watch these students work (somewhat as Tom Sawyer watched his playmates paint the fence), and then when it was done, he would apply his certificate. The architect would then inspect the work, make a few kicks for form's sake, and then issue the certificate; saying that the work was all right, but not saying anything about the beneficent Providence, which, in most cases, looked over it all and gave both architect and contractor the benefit of the doubt.

Another case of trouble was the practice pursued by some architects of letting the contract for electric wiring to a general contractor, who would then have to sub-let the wiring and other electrical work to an electrical contractor. The general contractor would always feel bound to let the electrical work to the man who could string the most wire for the least money; this, on the face of it, was a poor method, as money was the one gauge by which everything else was measured.

It is obvious that an architect cannot master every branch of electricity any more than he can master all of the technical details of plumbing, painting, stone-masonry, and the numerous other items which are necessary to complete the modern building. The wise architect (and he is generally over thirty) when he has an important building to undertake, will consult with experts in every important branch, and in so doing he will get in touch with the latest appliances and will have a specification that, when it is read, will not bring a smile to the face of the one who knows.

The demands for electrical apparatus are so numerous and important that the work of an electrical contractor should be independent of that of the general contractor, and he should be treated as an original contractor instead of as a sub-contractor. When an architect lets all of his so-called sub-contracts to what is known as a general contractor, he is simply trying to save trouble to himself; and in saving himself the immediate trouble, he is not conserving the interests of his employer (the owner), but is breeding trouble and consequent dissatisfaction for every one concerned.

The general contractor knows nothing about electricity; then why should he be employed, and why should the owner pay a double profit? By a double profit, I mean profit for an electrical sub-contractor and the other profit being for the general contractor who is supposed to shoulder all responsibility, which responsibility generally consists in figuring a large amount for the wiring and sub-letting it for the smallest amount possible without reference to quality.

The time of the specialist has come in every walk of life, and the expert electrical contractor will have to be recognized as a specialist and as an independent contractor by every architect and owner."

From Torch to Tungsten

The Canadian Sunbeam Lamp Company have recently completed a very telling demonstrating machine which is known by the title "From Torch to Tungsten." This machine was conceived with the intention of pointing out the gradual development that has taken place in illumination and to emphasize the efficiency of the "Sunbeam Mazda" lamp. This company is getting out, for the use of their dealers, some 25 other small demonstrating machines, which they will furnish on request. None of them are quite so elaborate, however, as the Torch to Tungsten demonstrator, four views of which are shown herewith. Fig. No. 1 begins with Rome, the period of Flares; Fig. No. 2 represents the Candle and Lamp period; Fig. 3 the Gas period; and Fig. 4 the incandescent electric light period. In the upper portion of each figure a house is shown illuminated with Sunbeam mazdas. The following brief description accompanies this demonstrating machine.

The different periods in which man has been able to increase the quantity and quality of artificial light in the world is the interesting story told by the Mazda Window Exhibit. From the smoking torch of primitive man, down the ages to the marvellous mazda electric lamp of to-day; from the eerie shadows of the dimly lit cave of the cave man to the brilliantly illuminated home of this year of grace 1914, is a long cry. The six epochs in the story of Light are set forth in ingenious detail in the six miniature homes that make up the Mazda Window Display. Lighting system and furniture are shown true to period.

Roman flares, 396 B. C.—The crude torch of primitive man gained ornament and usefulness at the hands of the Roman. In Rome, about 396 B. C., flares provided artificial light. The flares were long vase-like vessels of brass, capped with a bowl into which was placed resinous wood that burned like a brazier. Next came the Roman Candle—a string dipped in tallow and pitch. Another stage of the candle appeared in England in the form of a chip dipped in tallow.

Candles in England, 1483.—The second model in the exhibit shows the candelabra of England in 1483. The candles were of wax and grouped to give the required complement of light. For two hundred years after the perfection of the wax candle, illumination had not experienced any great improvement until the invention of the paraffin lamp.

Paraffin Lamp, 1842.—In 1842 the world welcomed the paraffin lamp. This lamp burned oil and was then thought to be the final word in the world of artificial light. This invention of a native of Alfreston in Derby, England, ruled supreme until the introduction of gas as an illuminant.

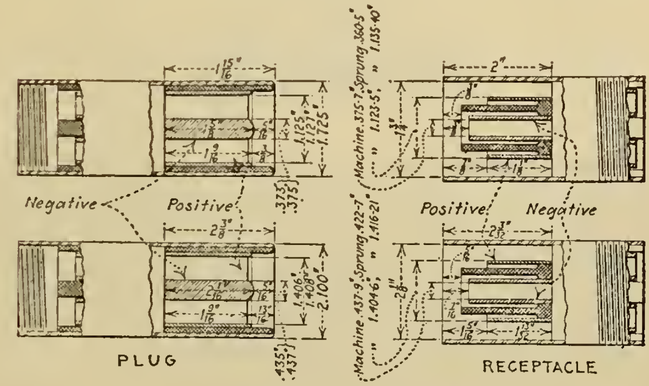
Gas, 1860.—The first recorded use of gas was about 1600, when a Scotchman with an inquiring mind, induced a gas flame by igniting the protruding end of a pipe inserted into a bladder filled with gas. His discovery was gradually improved and commercialized until in 1860 gas was used generally for illumination. Gas illumination received a great impetus when Humphrey Davy invented the arc light.

Electric Light, 1881.—The world of light was stirred by the advent of the first incandescent electric light, invented by Swan in 1881. Electric light has been gaining in service and use ever since that date. Electric illumination for home and office has reached its highest efficiency in the tungsten lamp, sold and used wherever there is darkness to dispel.

The period of the tungsten lamp.—The discovery and scientific application of tungsten—a ductile metal capable of being drawn out into cob-web like threads—has been the means of increasing by over 100 per cent. the efficiency of electric illumination as we have it to-day in the modern incandescent electric service. Delicate wires of tungsten inside the electric lamp form the core of a great white glow—greatest in intensity and least in cost. In the very latest types the vacuum, so long considered an essential of the incandescent, has been replaced by an inert gas, generally nitrogen. But this is only a refinement of the tungsten lamp.

Standard Charging Plug

The Electric Vehicle Association of America recently standardized a charging plug in both the 50 ampere and 150 ampere sizes. The details and dimensions of these plugs are shown in the accompanying cuts. The most noticeable feature is in connection with the polarity in connection with which it will be noted that the outside contact is positive and the inside contact is negative. The Association hope that every effort will be made by manufacturers and users to adopt this standardized plug as this would result in added satisfaction to the customer at reduced cost.



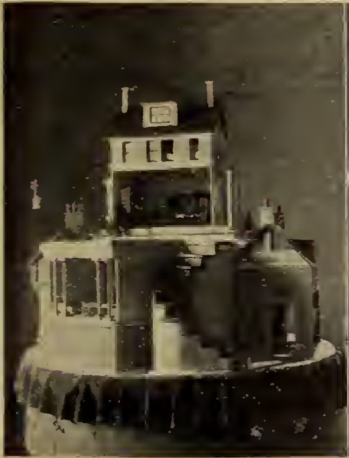


Fig. 1

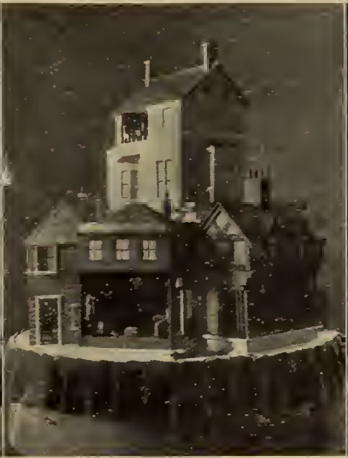


Fig. 2

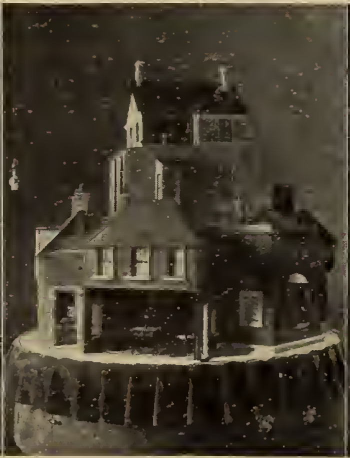


Fig. 3

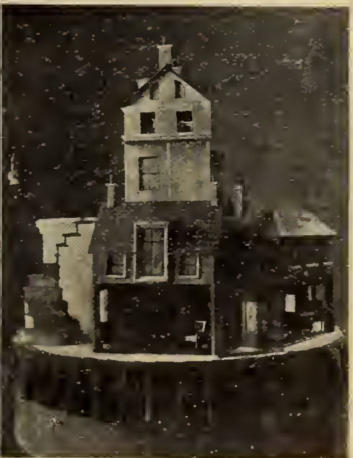


Fig. 4

Single Phase House Meter

The Siemens Company of Canada are placing on the Canadian market a single-phase house service meter possessing several original and interesting features that will no doubt appeal to power engineers interested in the sale of energy. The aim in designing this meter has been to so construct it that all the parts liable to deterioration through wear and tear can be very easily replaced without requiring the meter to be dismantled. Further, there is a total absence of soldered joints, all the internal connections in the meter being made by means of proper connectors. Where a number of small wires come together, which in the usual construction are soldered, in the Siemens meter they are brought down to a small terminal board and mechanically connected. The adjustments for the various loads are of a simple nature and accessible from the front. All these features, combined with good mechanical construction and simplicity in the arrangement of the parts make for permanence in the calibration.

The drawings in Figs. 1 and 2 give the front and side elevations of the W3 meter, and Figs. 3 and 4 are views of the renewable top and bottom bearings in detail. The motor part of the meter is built upon a cast iron base G. Part of the iron case forms part of the magnetic circuit of the meter. The laminated iron yoke E consists of three limbs, as shown in Fig. 5, the middle limb being somewhat broader than the two outer limbs. The magnetic circuit is closed through a projection in the casting of the iron case G, as shown in side elevation Fig. 2.

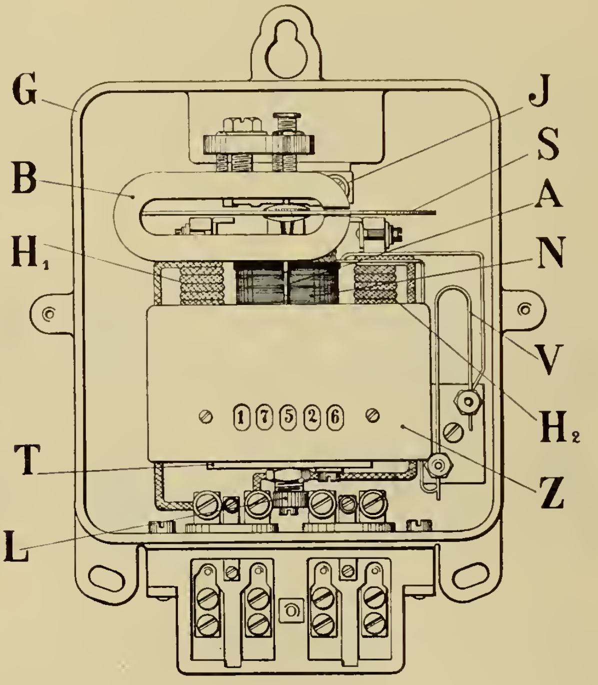


Fig. 1

In the slot or air space between the pole faces and the above mentioned cast iron projection, room is provided for an aluminium armature disc to rotate on this spindle A. On the middle limb of the yoke E is wound a shunt or pressure coil N and on the two outer limbs are wound the two outer current coils H_1 and H_2. The shunt winding consists of two parts, the main shunt winding and the auxiliary winding K, giving the necessary phase adjustment for inductive loads. The auxiliary winding K is adjustable by means of the resistance wire V. The meter armature is braked by a permanent magnet B; on the armature spindle A is the worm O, which gears into the first wheel of the counting train Z, the counting train being of the same pattern as in the W_{10} and W_2 types.

Special attention has been directed to both the top and the bottom bearings, which are described in detail accordingly:—

Top Bearing.—Referring to the drawing in Fig. 3, N is the spindle of the meter armature, P an oil well in which the top pivot L works and supports the armature spindle N. The oil well is contained in a sleeve O, which can be withdrawn by means of a tool which screws on to an outside thread of the sleeve O provided for this purpose. To examine or renew the top bearing and its oil well the nut M is first loosened and the screw K which contains the pivot L can be withdrawn. A special tool provided with an inside thread is then inserted and screwed on to the sleeve O which can then be removed from the spindle N by a gentle pull. Only the finest clock oil is used.

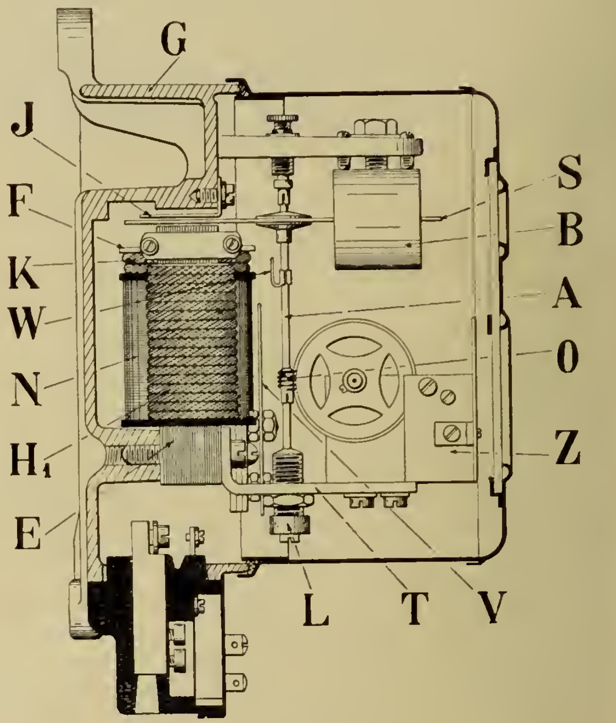


Fig. 2

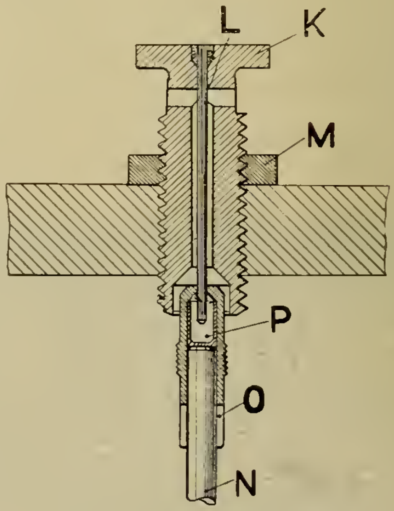


Fig. 3

In putting the parts back again, similar operations are performed, but in the reverse direction, i.e., the sleeve O is screwed into the special tool provided, and it can then be pushed onto the spindle X as far as the bottom of the oil cup P against which the top of the spindle X sits. The tool can then be withdrawn by unscrewing it off the sleeve O and pivot screw K can be screwed home, care being taken to see that the pivot point L is not damaged in inserting it into the oil well P. The distance of "Shake" having been adjusted, K should be secured by the lock nut M.

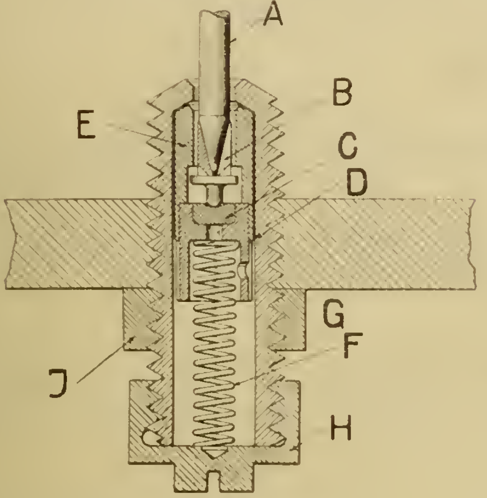


Fig. 4

Bottom Bearing.—Referring to drawing in Fig. 4, B is the detachable pivot of the meter armature spindle A resting on the jewel stone C. To renew the bottom jewel, the nut H should be unscrewed, this will expose a spring F, a gentle pull on which will bring away the bottom jewel C and also the bottom pivot B which is held by oil cap E fitting over the jewel holder D. The various parts all come away as one piece, and are intended to be renewed as such, but the cap E can be removed so that the pivot point B and the jewel stone C can be examined or renewed. The spindle A is shaped to a cone at its bottom end, so that the pivot point B is held friction tight when the nut H is screwed home.

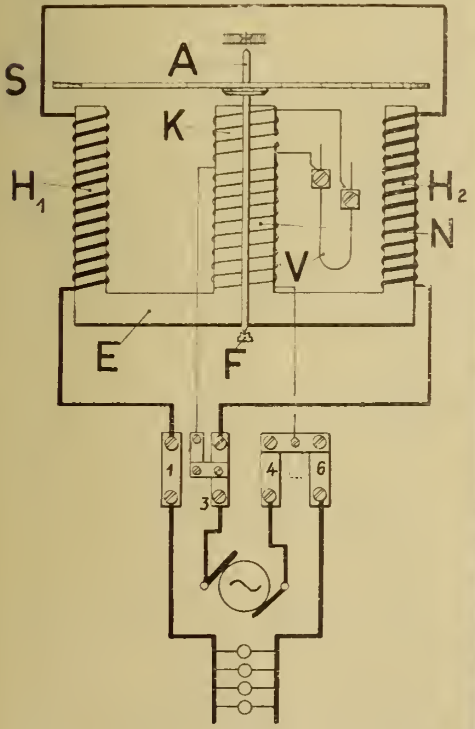


Fig. 5

The meter will start on a load of between 0.5 and 1 per cent. of full load. The starting current adjustment consists of a copper shoe J screwed to that projected part of the cast iron base which completes the magnetic circuit. The shoe J is slotted for adjustment purposes.

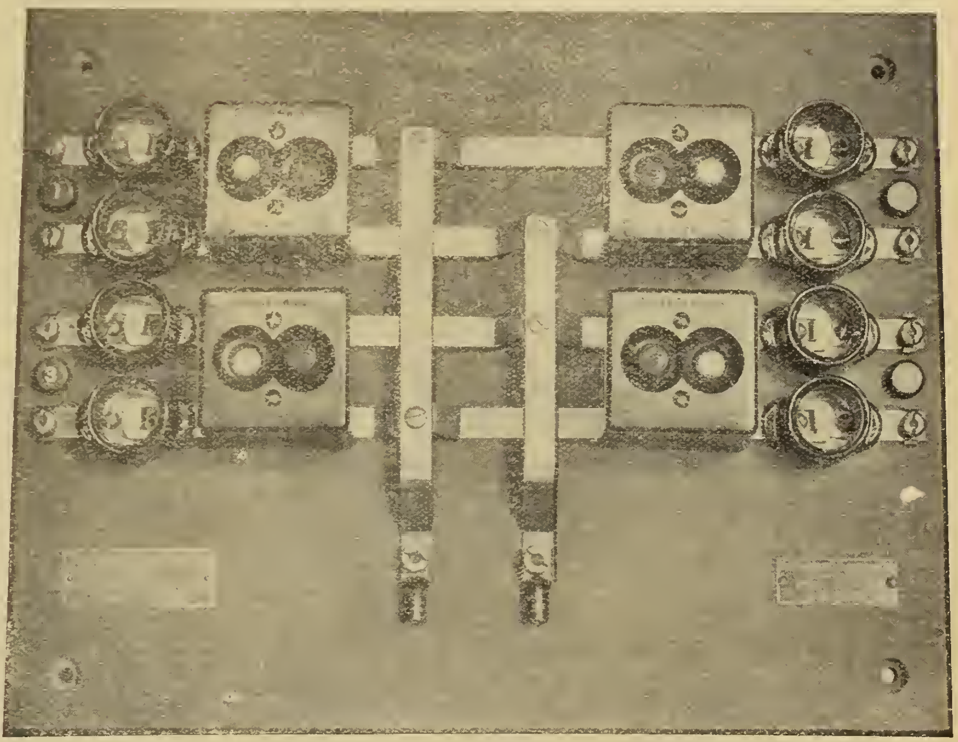
In order to prevent the meter from the risk of running on the shunt alone, a small piece of bent iron ribbon W is fixed to the spindle A, so as to be attracted by the magnetic leakage of the shunt or pressure coil X.

As before mentioned the whole of the meter is built and secured to the cast iron base G, which is closed completely by a sheet metal dust-tight cover, and a separate cover is provided for the terminal box. The terminal box can be separately sealed, and both ends of the pressure circuit are available for testing purposes without breaking the seal of the meter cover proper.

An arrangement which is typical of the ingenuity employed in the construction of the meter is the way in which the holding down screws of the cover are made. The screws just under the head are necked down in such a way that the cover may be loosened and taken off without having to remove the screws from the cover. It thus becomes practically impossible to lose these screws. This is only a little point but one which will be no doubt appreciated by meter testers and others who have to handle the meters, as the screws cannot be mislaid or dropped.

New Panel Board

A new type of panel board has just been placed on the market by the Crouse-Hinds Company of Canada an example of which is illustrated herewith. This board is of the push button switch type which this company in future will standardize and in which line they will carry a very large and complete stock from two to thirty circuits inclusive. If specially ordered new panel boards will be furnished with the fixtures of any particular manufacturer required. The simplicity and neatness of the board are very apparent from the illustration.



High Pressure Pumping Equipment

The Westinghouse Electric & Manufacturing Company have entered into a contract with the city of Boston, Mass., for all machinery and equipment for a central high pressure fire pumping station. This contract includes six 3000 gallons per minute 6-stage centrifugal pumps; six 700 h.p., 6000-volt, 60-cycle motors; six 13200-volt, 25-cycle, 800 h.p. motors, complete with switchboard and controlling apparatus; also necessary travelling cranes, and all heavy piping and large valves for the complete equipment of the station.

Each pump will be connected by a magnetic coupling on one end to a 700 h.p., 60-cycle motor and the other end to an 800 h.p. 25-cycle motor. Under normal operation each pump is driven, its 60-cycle motor furnished with current from the lines of the Edison Electric Illuminating Company of Boston. Should any mishap, however, occur to the 60-cycle supply, the pump can be instantly operated by its 25-cycle motor fed from the lines of the Boston Elevated Railroad Company. The increased size of the 25-cycle motor is due to its speed being 732 revolutions per minute, while that of the 60-cycle motor is 702 revolutions, these speeds, of course, being determined by the respective frequencies of the circuits. The motors have wound secondaries, and they do not start until the first point of the automatic controller has been passed. At this point the circuit of the magnetic clutch between the motor and the pump is completed.

The 800 h.p. motor will be the highest voltage wound secondary motor ever built—13,200 volts being the potential for which it is designed.

The business district is to be underlaid with special high pressure water mains to be used for fire service only, and in case of fire within this district, the alarm is sounded in the pumping station and in the fire houses simultaneously. This permits the electrically operated pumps being started at once, and the pressure raised in not more than 45 seconds to 300 lbs. per square inch all over the system of high pressure mains. Upon arrival of the fire hose at the point of the fire, the hose can be connected directly to the special high pressure hydrants, and water taken directly from the mains at sufficient pressure to render the use of steam fire engines unnecessary and useless. This is a system which is coming into favor in congested business districts, as it gives increased protection and makes it unnecessary to rush through the dense traffic of such districts with heavy steam fire engines.

The contract has been awarded for the wiring and lighting of Toronto's Civic Abattoir to the Toronto Electric Company. The work will be under the personal charge of Mr. J. W. Helps.

Mr. E. W. Sayer, of the Sayer Electric Company, has been elected second vice-president of the Montreal Builders' Exchange.

New Companies

The Canadian Halley's Motors, Limited, has been incorporated with capital $10,000 and head office Montreal.

The Keystone Electric Company, Limited, has been incorporated with capital stock $75,000 and head office Hamilton.

La Compagnie Electrique de Saint Polycarpe has been incorporated to exploit some water powers in the county of Soulanges. The head office of the company is at Couteau Landing.

The Canadian Callophone Company, Limited, has been incorporated with head office Victoria. This company has acquired Canadian rights for certain existing inventions in relation to a loud sound producer and sensative sound receiver known as the callophone.

The Central Garage & Electric Company, Limited, has been incorporated with capital $7,000 and head office Moncton, N.B.

Trade Publications

Memoir No. 3.—Issued by the Department of Mining of Canada describing, with illustrations, the basins of the Nelson and Churchill rivers; compiled by Mr. Wm. McInnes.

Catenary Line Material.—Catalogue DS843 issued by the Westinghouse Electric & Manufacturing Company illustrating and explaining the details of their catenary line material.

Small Motors.—No. 18 of the monthly issue of small motors by the Westinghouse Electric and Manufacturing Company treating the subject of small electric motors and their application.

Induction Motors.—Bulletin No. A-4185 issued by the power and mining department of the Canadian General Electric Company describing and illustrating type KS. single-phase induction motors.

Motor Starters.—A folder issued by the Allen-Bradley Company, of Milwaukee, describing their type H alternating motor starters. The company lay particular stress on the protective features of this rheostat.

Simplex Manual.—Booklet issued by the Simplex Wire & Cable Company of Boston, containing, in addition to information regarding simplex brackets, tables and data for the ready reference of electrical engineers, contractors, wiremen, etc.

Your Silent Salesman.—A very interesting booklet issued by the Canadian Sunbeam Lamp Company, Limited, Toronto, describing a number of very interesting window displays that have been devised by this company to demonstrate the efficiency and stability of their lamp products.

Safety First.—A booklet issued by the Accident Prevention Committee of the National Electric Light Association explaining how to organize and carry out a campaign for the prevention of accident. The booklet is divided into five sections:—Introduction, Organization, Method of Procedure, Educational Methods, Conclusion.

Canadian Westinghouse—have issued the following publications—a folder describing ventilating outfits; a folder called "The ABC of battery charging"; circular No. 1156 describing type S and type R direct current generators, with profuse illustrations; and publication 1525 describing Baldwin-Westinghouse electric mining locomotives, also fully illustrated.

A.C. Motors.—Pamphlet No. 22A issued by Bruce, Peebles & Company, Limited, Edinburgh, describing the Peebles alternating current motors, polyphase type. The pamphlet is divided into two parts, the first dealing with open type machines and the second with a very compact form of motors made in fairly large sizes with bearings self-contained. These latter motors are specially suited for direct coupling to fans, pumps, and similar apparatus.

Overhead Runways—Bulletin No. A-12 issued by the Herbert Morris Crane & Hoist Company, Limited, Toronto, describing, with illustrations, some very interesting, recent installations made by this company. The Morris runway is shown in the warehouse, paper mill and foundry, and the modifications of the equipment to suit varying conditions is indicated in a very interesting manner.

Current News and Notes

Amherst, N.S.

The committee on street lighting have placed an ornamental pole, carrying a cluster of tungtens, on the main street for observation purposes as it is the intention to improve the street lighting at an early date.

Belleville, Ont.

It is expected that work on the installation of a new street lighting system will be commenced almost immediately.

Biggar, Sask.

The municipal council are considering the question of a municipal electric plant but have not yet decided whether they will give a franchise or build and operate a municipal plant.

Brantford, Ont.

The city council has passed a by-law authorizing the issue of debentures to the amount of $70,000 for hydro-electric extensions.

Buckingham, Que.

The municipal council are contemplating the installation of an electric lighting system.

Bury, Que.

The Westbury Heat, Light & Power Company are negotiating with the municipal council of Bury regarding a 20 year franchise to furnish electric energy to the municipality.

Calgary, Alta.

The Eau Claire & Bow River Lumber Company, Mr. P. A. Prince, manager, are installing an addition to their water power plant which consists of two 50-inch Samson turbines. The same company contemplate an addition to their steam plant and expect to add gas engines to develop 1500 kw. This company is closely associated with the Calgary Water Power Company.

As a result of a considerable surplus shown by the Electric Light & Power Department of Calgary the rates have been reduced by between 6 and 7 per cent.

Cannington, Ont.

Tenders are called for transformer equipment at this point by the Hydro-electric Power Commission of Ontario.

Drumbo, Ont.

By-laws were recently passed authorizing electric supply agreements with the Hydro-electric Power Commission of Ontario in Drumbo, Glassville and Princeton.

Edmonton, Alta.

The Lacombe & Blindman Valley Railway Company are desirous of increasing their borrowing power to $30,000 per mile.

The Western General Electric Company, Limited, have increased their capital from $100,000 to $500,000.

Fernie, B.C.

Rates in Fernie have been reduced from 15c per kw.h. to 13c with discounts varying from 15 to 40 per cent., the latter being given if over 750 kw.h. per month are used; a meter rate of 15c a month for residences and 25c a month for other purposes is charged. The power rate varies from 12c down to 2c per kw.h. The 2c rate is given if over 1800 kw.h. are used in any month; an extra 10 per cent. is allowed for prompt payment.

Glencoe, Ont.

The municipal council of Glencoe have approached the Hydro-electric Power Commission of Ontario and will get a report on the cost of supplying light and power.

Goderich, Ont.

The Marine Department of the Dominion Government have decided to install a powerful electrically operated foghorn at Goderich.

Hamilton, Ont.

The Standard Underground Wire & Cable Company have been awarded a contract for 60,000 lbs. of copper wire required by the Hydro-electric Department.

Tenders will shortly be called for 500 standards and lamps.

Tenders are called to February 15 for a year's supply of meters of various sizes amounting to between 4,000 and 5,000.

Hull, Que.

The extension of the electric railway to Gatineau Point is being considered.

Kisbey, Sask.

The South Kisbey Rural Telephone Company have been authorized to spend $6,500 in construction work.

Kingston, Ont.

It has been stated by the Canadian Northern Railway Company that they will probably place a gas-electric car on their line between Harrowsmith and Kingston.

The Napanee Improvement Company have made a proposition to the Kingston council regarding the supply of cheap electric power from a suggested development at a point known as Third Depot Lake where there is said to be from 1,000 to 2,000 h.p. available. The communication was made to the council through Mr. A. W. Benjamin, of Yarker.

Lindsay, Ont.

The Electric Power Company recently chartered a special train to carry a number of prominent officials of Belleville, Campbellford and the intermediate districts to inspect the new system of magnetite arc lighting on Kent Street, Lindsay. The visitors were greatly pleased with the Lindsay installation and satisfied that it would meet their own requirements. The Electric Power Company place their engineering organization, free of charge, at the disposal of any municipality that may have electrical problems in wiring, lighting or power extensions.

Lacombe, Alta.

A contract has been awarded to the Canadian General Electric Company for a 100 kw., 2300 volt, 3-phase, 60-cycle, 277 r.p.m. engine driven generator.

London, Ont.

At the annual meeting of the London Street Railway Company the matter of purchase of a half-dozen more cars was taken up.

A conference of the various municipalities interested in hydro-radials will be held in London in the near future. It is the intention to issue invitations to all municipalities in the neighboring districts who will send representatives.

Melfort, Sask.

The municipality of the town of Melfort recently placed their new electrical equipment in commission. This consists of a 150 h.p. Diesel engine direct connected to a 90 kw., 2200 volt, 3-phase, 60-cycle generator. The engine was supplied by the Boving Company of Canada and the electrical equipment by the Canadian General Electric Company.

Merrickville, Ont.

Tenders are called by the Department of Railways and Canals for the construction of a concrete dam. Tenders are received up to February 12.

Montreal, Que.

Norton Griffiths & Company, of London, Montreal, and St. John, N.B., have offered, in conjunction with W. H. Brown & Company, of New York, to organize an operating company with $25,000,000 capital to build a comprehensive system of subways in Chicago. The fare is not to exceed five cents. The surplus profits are to be divided: 55 per cent. to the city and 45 per cent. to the company.

The Montreal council have authorized a loan of $2,000,000 to establish and maintain a municipal electric plant, in connection with the enlargement of the aqueduct, work on which is now being carried out. It is proposed to develop 10,000 horse-power, 6,000 for pumping water and the remainder for lighting.

The Montreal Light, Heat and Power Company are completing a ten storey addition to their offices. The exterior is of Indiana limestone with carved frieze and heavy ornamental cornices, which give it a very attractive appearance. The interior woodwork is of solid oak and the corridors and entrance halls are finished with Terrazzo floors and marble dados. The addition is equipped with three electric elevators, one of which is to be a combination freight and passenger elevator.

The Bell Telephone Company will cut in their new exchange on Rockland Avenue, Montreal, on February 28, with about 2,500 lines from the St. Louis exchange.

When market conditions are favorable the directors of Price Bros. and Company will dispose of $600,000 bonds of the subsidiary Shipshaw Water Power Company. The power company's development is at Murdock Falls, about two miles from Kenogami, and the present installation consists of 6,600 h.p. Provision is made in the power station to bring the capacity of the plant up to 10,000 h.p. at a cost of $40,000 for the additional unit. The company has entered into an agreement with Price Bros., by which it sells 5,000 h.p. at $15 per h.p. The water power was purchased and developed by the Jonquiere Pulp Company, and sold to the Shipshaw Water Power Company for $600,000 bonds and $100,000 common stock. Gross earnings of the power company are estimated at $75,000 for 1914, net at $67,000 and surplus after bond interest at $37,000.

Moose Jaw, Sask.

Tenders are called up to February 23 for an electric elevator for a public building to be built here. Tenders are received by the Department of Public Works, Ottawa.

New Glasgow, N.S.

The Eastern Steel Company are installing an electrically driven coal handling plant for the municipal power plant, Regina, Sask.

North Vancouver, B.C.

Mr. J. Findley, chief of the fire department, has recommended the purchase of 30 additional fire alarm boxes.

Niagara Falls, Ont.

It has been recommended by the town engineer that the River Road be lighted for a distance of some two miles with ornamental standards and arc or incandescent lamps.

Nanaimo, B.C.

It is probable the Nanaimo Electric Light & Power Company will require additional generating equipment during the year as the company are making considerable extensions to their distribution system.

Ottawa, Ont.

The Cedars Rapids Manufacturing and Power Company have submitted to the government a plan for a transmission line from their generating plant near Montreal, to Cornwall It is the intention of the company to make Cornwall a distributing centre for the towns and municipalities in that district.

W. C. Edwards & Company are applying to the Dominion Government for power to extend their charter rights so that they may sell electric energy not required in their own establishment for light and power purposes.

The Department of Public Works recently awarded a contract for the construction of a dam on the French River. This dam is built primarily in the interests of navigation but a considerable amount of electric power will be developed, some of which will be required for the operation of the dam and the lighting of the navigable channels in the immediate vicinity.

Portage la Prairie, Man.

The city of Portage la Prairie are applying to the provincial legislature for an extension to their charter rights sufficient to allow them to erect a transmision line outside the city and to deal in power, etc. The supposition is that these rights may be used to bring power from Winnipeg.

Port Stanley, Ont.

Extensions are contemplated to the government lighting system at this point.

Regina, Sask.

The operating returns of the municipal street railway system for the week ending January 24, 1914, are as follows:—Revenue, $3,889.25; number of passengers carried, 94,601; passengers carried including transfers, 105,439.

Saskatoon, Sask.

The municipality have just added to their generating equipment a 3,000 kw. steam turbo-generator, two-phase, 2300 volts, 60-cycles, 3600 r.p.m., complete with motor-operated field rheostat and remote steam control for the steam turbine. The equipment also includes a surface condenser complete with necessary motor driven air pump and motor driven condensate pump. The equipment was supplied by the Canadian Westinghouse Company.

Simpson, Sask.

The Simpson Rural Telephone Company contemplate the erection of a telephone exchange to cost $10,000.

St. John, P.Q.

The Bell Telephone Company's exchange at St. John, P.Q., has been changed from the magneto to the central energy system.

Stratford, Ont.

A by-law recently passed authorizing the expenditure of $20,000 for further electric extensions.

Strathroy, Ont.

A by-law will be voted on February 16 providing $25,000 for the cost of a distribution system.

Sudbury, Ont.

An ornamental system of lighting on the main streets of the town is being considered at present by the town council. An addition to the power plant is also contemplated.

Smithers, B C.

The new electric plant was turned on in Smithers on

January 23. This plant is of interest owing to the fact that it is only about four months since the first house was built in Smithers and they now have a plant capable of supplying 4,000 lights.

Sydney, N.S.

The Cape Breton Electric Company's new ferry boat "The Electronic" has just been placed in commission.

Thamesford, Ont.

Hydro-electric light was turned on in the streets and homes of Thamesford on January 27.

Toronto, Ont.

Alderman Dr. Wickett, chairman of the Civic Transportation Committee has stated that the Ontario Railway & Municipal Board will probably act on advice at present being secured by a New York engineer regarding the building of new lines by the Toronto Railway Company.

Governor Glynn of New York State and other state officials are urging the House of Foreign Affairs Committee to allow a diversion of 20,000 cu. ft. of water per second from the Niagara. The present limit is 15,000 cu. ft. per second. The addition would represent a development of between 300,000 and 400,000 horse-power.

Following the mishap to the transmission line of the Hydro-electric Power Commission of Ontario on January 31, it is likely the work of installing another transmission line between Niagara Falls and Dundas will be hastened.

It is reported that the Toronto Street Railway Company are planning to erect two new car barns.

The annual statement of the Toronto Railway Company for the year 1913 shows the gross income to have been $6,649,919, as compared with $5,448,058 in 1912. Operating expenses absorbed $3,123,308, leaving a net of $2,925,710, as compared with $2,581,500 the previous year. The gross earnings of the Toronto & York Radial Railway are given as $584,491, as compared with $492,923 in 1912. The gross assets of the Toronto Railway Company are placed at $21,748,605. After paying all charges including percentage on earnings, bonds, interest and taxes there is a surplus on hand for the year of $1,633,812, and after deducting interest on the common stock amounting to $879,958 there is a surplus to carry forward of $753,854. Added to the balance carried forward from the previous year of $3,694,757 the total surplus now brought forward amounts to $4,448,611.

Vancouver, B.C.

The Granby Mining & Smelting Company's new plant at Hidden Creek is reported to have begun operations. The equipment includes an electric tramway line and a hydro-electric power plant.

J. S. McDonald, of Eau Claire, Wis., is said to be considering the establishing of an iron and steel plant in Vancouver where they will manufacture, among other things, gas-electric equipment.

For tapping his service wires so that current consumed was not registered on his meter, a customer of the B. C. E. R. Company has been fined $500 with an option of six months' imprisonment.

Vernon, B.C.

It is announced by the local manager of the Okanagan Telephone Company, Mr. G. H. Dobie, that trunk lines will be completed by next autumn so that conversation between the Okanagan Valley and coast cities will be possible.

Windsor, Ont.

The Hydro-electric Power Commission of Ontario have made an estimate of the value of the distribution system of the Sandwich, Windsor & Amherstburg Railway Company in Windsor, placing the value at $155,000, not including the generating station. The report was made in connection with the proposed purchase of this system by the town.

Williamsburg, Ont.

A vote will be taken shortly on the question of a supply of light and power by the Hydro-electric Power Commission of Ontario, from a transformer station to be erected at Morrisburg.

Wolseley, Sask.

The Durham Rural Telephone Company will spend $4,500 on construction work.

Woodstock, N.B.

The county councillors have given consent to the Maine & New Brunswick Electric Power Company to erect their 30,000 volt transmission line through the township to the town of Woodstock. This company develop power at Aroostook Falls, N.B., and will supply power to the municipalities along their new transmission line and in Woodstock.

Welland, Ont.

At the annual meeting of the Niagara, Welland & Lake Erie Railway Company it was announced that work would be commenced shortly on the construction of extensions from Welland to Port Colborne along the lake shore to Fort Erie and thence along the river to Niagara Falls, Ont.

Wilkie, Sask.

It will be some months before the town of Wilkie is in a position to submit a by-law and make the contemplated extensions to their power plant.

Yorkton, Sask.

The town of Yorkton will proceed with the construction of a new power-house immediately, the intention being to have this building ready by the first of July.

Lighting Schedule for March, 1914

Courtesy of the National Carbon Company, Cleveland.

Date.	Light.	Date.	Extinguish.	No. of Hours
Mar. 1	6 20	Mar. 2	5 50	11 30
2	10 10	3	5 50	7 40
3	11 20	4	5 50	6 30
5	0 20	5	5 50	5 30
6	1 20	6	5 50	4 30
7	2 10	7	5 40	3 30
8	3 00	8	5 40	2 40
9	3 30	9	5 40	2 10
10	No Light	10	No Light	
11	No Light	11	No Light	
12	6 30	12	8 30	2 00
13	6 30	13	9 50	3 20
14	6 30	14	11 10	4 40
15	6 30	16	0 30	6 00
16	6 40	17	1 50	7 10
17	6 40	18	2 50	8 10
18	6 40	19	3 50	9 10
19	6 40	20	4 30	9 50
20	6 40	21	5 20	10 40
21	6 40	22	5 20	10 40
22	6 40	23	5 20	10 40
23	6 40	24	5 10	10 30
24	6 50	25	5 10	10 20
25	6 50	26	5 10	10 20
26	6 50	27	5 10	10 20
27	6 50	28	5 10	10 20
28	6 50	29	5 10	10 20
29	6 50	30	5 00	10 10
30	6 50	31	5 00	10 10
31	10 10	Apr. 1	5 00	6 50
Total Hours				215 40

Condensed Department

Publisher's Notice

Advertisements under "Situation Wanted" "Situation Vacant" or Miscellaneous, are charged at 2 cents a word per insertion, minimum charge 50 cents.

Advertisements for tenders, equipment, wanted or for sale, etc., are charged at $2.10 per inch.

All advertisements must be in the publisher's hands by the 10th or 23rd of the month to insure insertion in the subsequent issue.

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Bought, sold, rented, and exchanged. We have the largest stock in America. Send for our monthly bargain sheet showing complete stock with our prices.

GREGORY ELECTRIC CO.
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Wanted Employment

Partnership—Young man wishes an active partnership. Excellent mechanic, machinist and electrician, with good knowledge of gasoline and steam engines and pumps, also estimating and contracting work. Can invest some capital. Address Box 948, Electrical News, Toronto. 3-4

Electrical and mechanical engineer, Associate A.I.E.E., having executive ability; technically trained with ten years' experience as operating engineer-in-charge of central station plant; marine engineer, estimator in commercial department, manufacturing company and chief assistant to consulting engineer. Gladly give references and further particulars. Address, Box 963, Electrical News, Toronto. 4

Electrical engineer, graduate B.A.Sc., 22, unmarried, with one year's experience, desires position with consulting engineer or manufacturing company where opportunities for advancement are good. Salary secondary. Box 952. Electrical News, Toronto. 3-4

Electrical and Mechanical Engineer, Associate A.I.E.E., desiring a change, wishes to correspond with parties in need of a good man. Is experienced in manufacturing, erecting, transmission, distribution, testing, operation and maintenance. Is at present electrical superintendent for large mining corporation. Address Box 944, Electrical News, Toronto. F

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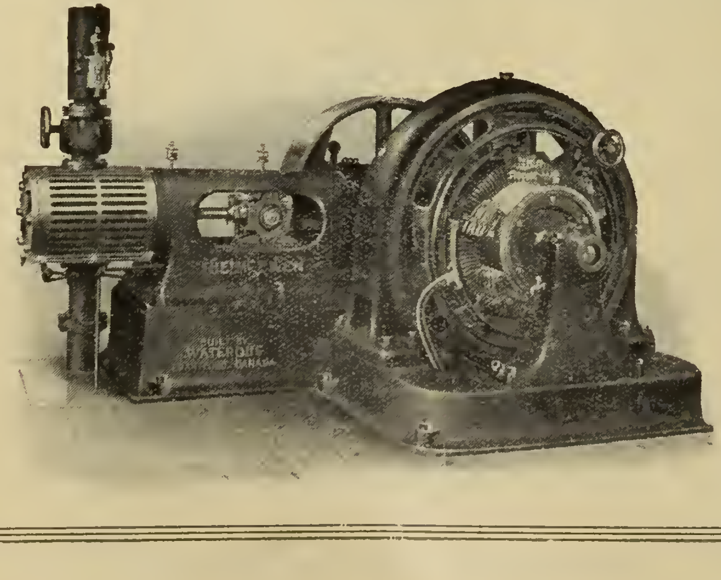

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A simple and sturdy design—steam valves that are absolutely tight—a governor that permits of the closest regulation—an oiling system that gives perfect lubrication—These are some of the features that have placed McEwen Engines in hundreds of steam plants in Canada.

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Miniature Precision Instruments for Direct Current

Model 280, Single Range Portable Voltmeter.
(One-quarter size.)

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A new group of very small Indicating Instruments.

COMPACT—ACCURATE— DURABLE—BEAUTIFUL

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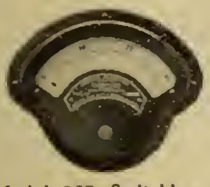
The Volt-Ammeter comprising six instruments in one.

This group also includes BATTERY TESTERS.

SWITCHBOARD

Voltmeters Volt-Ammeters Ammeters Mil-Ammeters



Model 267, Switchboard Ammeter.
(One-quarter size.)

Model 268, Switchboard Volt-Ammeter. Reads Amperes. Press Button for Volts.
(One-quarter Size.)

This new line of instruments represents the latest development of the pivoted moving coil, permanent magnet type for low ranges.

The refinement of design and mechanical work in them has been carried to a degree which would appear to be almost impossible of accomplishment, if the results were not evident in the instruments themselves.

They embody characteristics which have made the well known Weston Standards famous throughout the world.

They are accurate, dead beat and extremely sensitive.

They may be left continuously in circuit at full load without injury and are shielded against the external electrical and magnetic influences of other apparatus in their vicinity.

They are substantially constructed and may be safely sent long distances through the mails and will withstand an extraordinary amount of vibration without injury.

They have the longest scale ever provided in instruments with equal length of pointer.

Each model has been thoroughly tested under the most severe conditions of service and in experiments extending over more than one year.

The portable instruments may be conveniently carried in the coat pocket.

The prices have been established upon so low a scale that any one may possess one or more of these remarkable instruments at moderate cost.

If you cannot obtain the instrument desired from your dealer, write us.

The several models and ranges offer a selection from over 300 different combinations, listed in Bulletin No. 8. Will be mailed upon request.

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No. 13, same as No. 12, except larger and very much louder, and is for signalling purposes on high tension 60 cycle. Fully approved by Underwriters.

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4070—10 inch diameter
4071—12 inch diameter
4072—14 inch diameter
4073—16 inch diameter
4074—18 inch diameter

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Our latest creation for office lighting is here shown. This semi-indirect bowl of Moonstone Glass transforms the harsh direct rays of the tungsten lamp to a soft even atmosphere of light.

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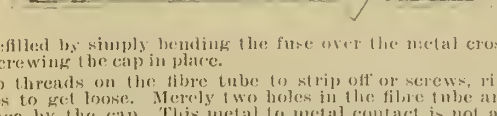

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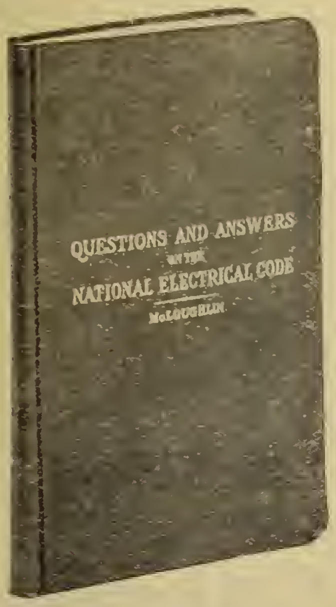

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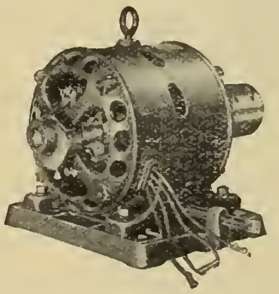

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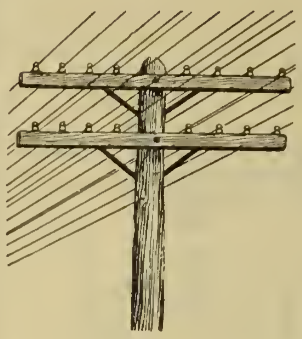

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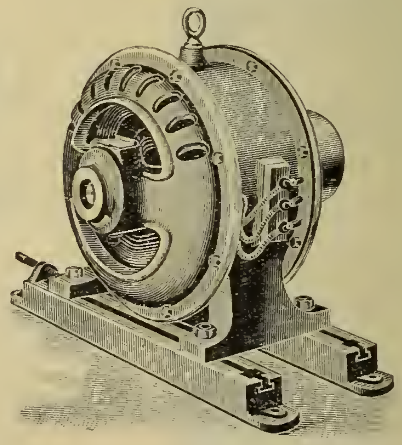

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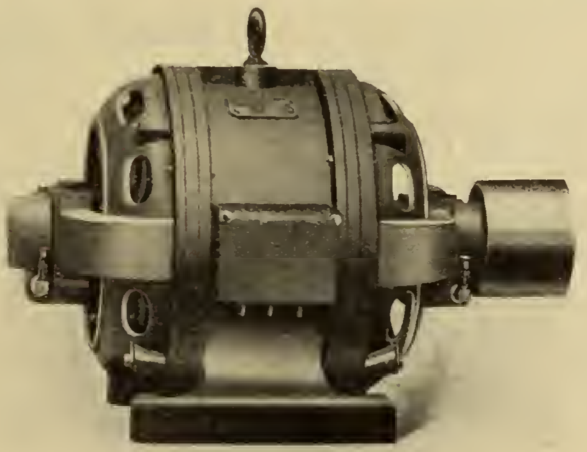

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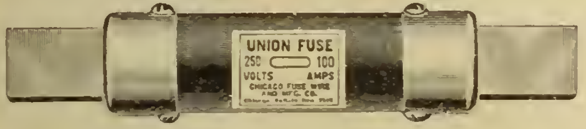

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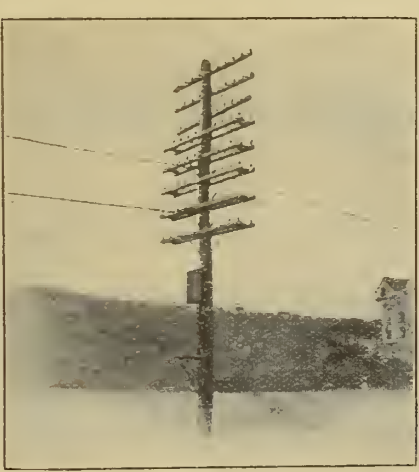

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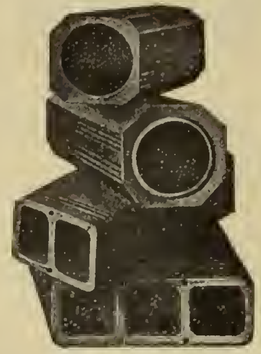

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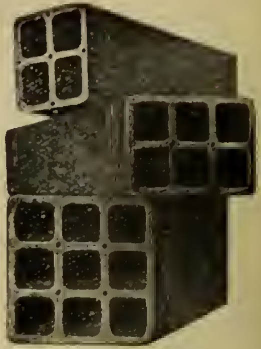

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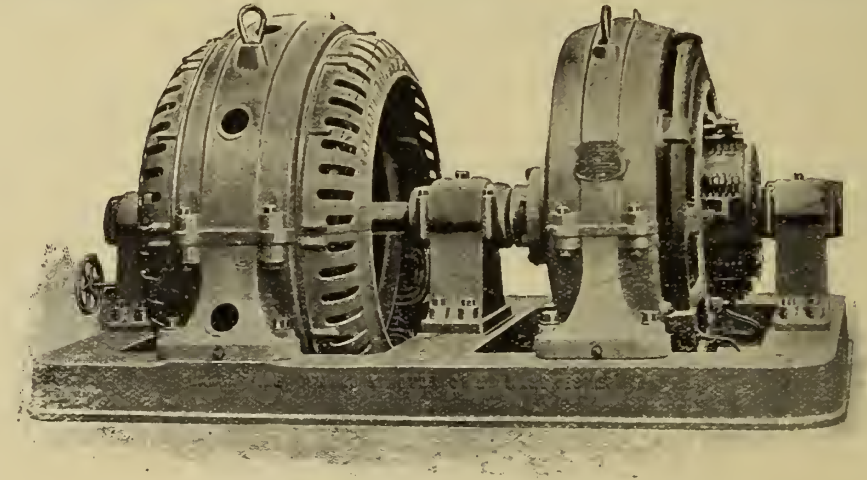

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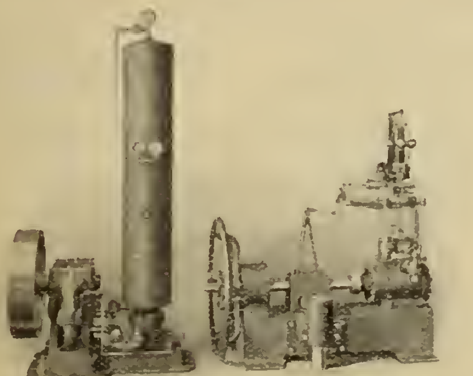

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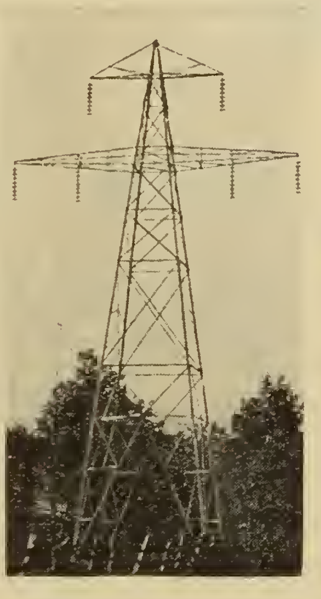

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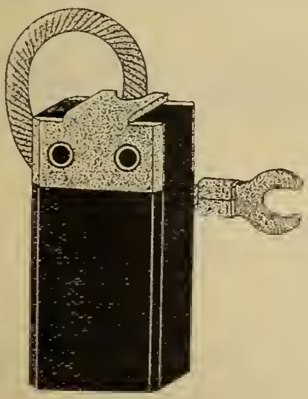

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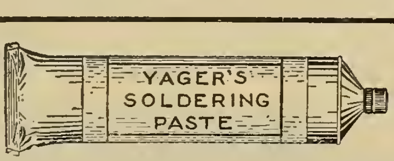

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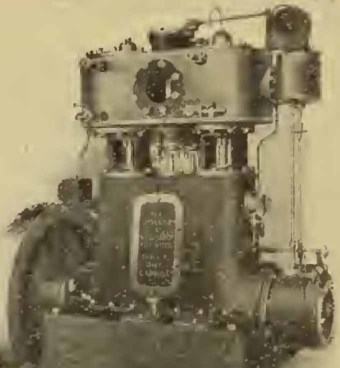

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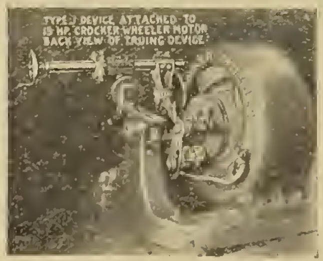
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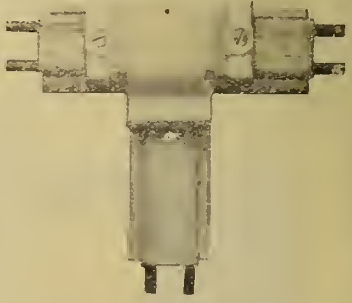

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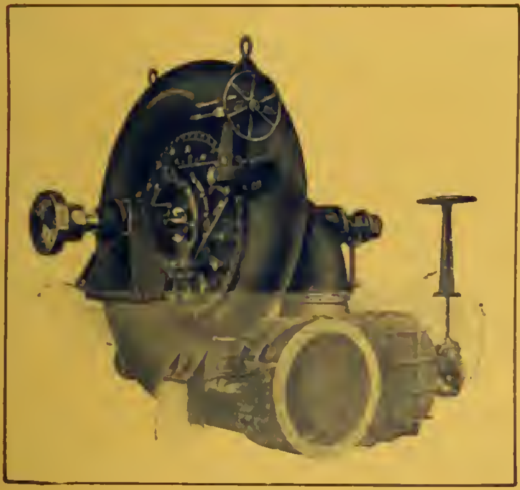
SPENCER & ASPINALL, 617 New Birks Bldg., Montreal, P. Q.

Electrical News

Generation, Transmission and Application of Electricity



90% EFFICIENCY

From SMITH HYDRAULIC TURBINES

Recent tests at Holyoke, Mass. on Standard Smith Turbines have again proven their superiority over any turbine now manufactured.

These tests showing efficiencies from **89% to over 90%**.

We design and build turbines for heads from 5 feet to 650 feet. Engraving represents a turbine of 900 H.P., 250 R.P.M., 110 feet head.

Send for Bulletin N

S. Morgan Smith Co., York, Pa.

Branch Offices: 176 Federal St., BOSTON, MASS.
614 American Trust Bldg., CHICAGO

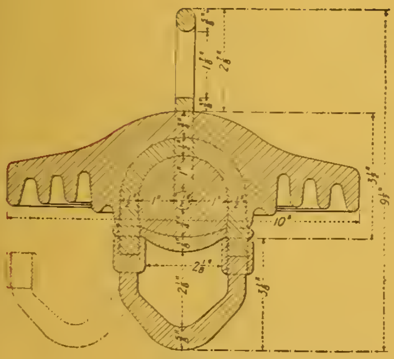
ARRIVED!

TRADE **ELECTROSE** MARK.
REG. U.S. PAT. OFF. & FOREIGN COUNTRIES.

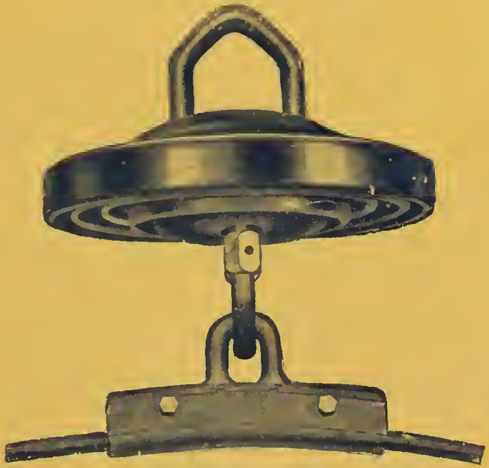
TRADE **ARCOVER** MARK.

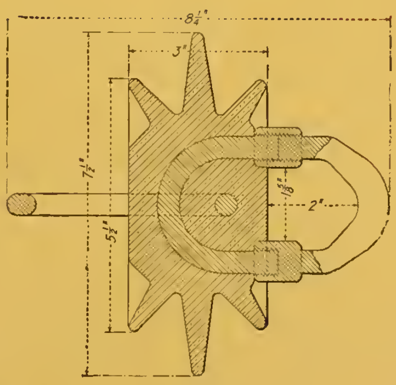
LIGHTNING-PROOF LINE AND STRAIN INSULATORS

LOUIS STEINBERGER'S PATENT



No. 9302





No. 162

The Best Insulators are the Cheapest in the End.

SOLE MANUFACTURERS

ELECTROSE MFG. CO., 60-72 Washington St.
66-76 Front St. **Brooklyn, N.Y., U.S.A.**

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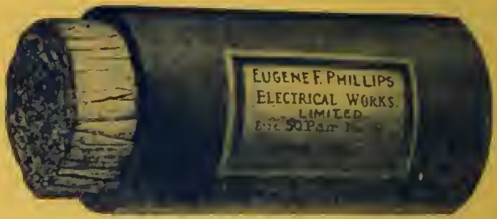
PHILLIPS

Bare and Insulated Copper

WIRES AND CABLES



For Telephone, Telegraph, Lighting, Power and Street Railway Equipment

Bare and Insulated Electric Wire and Cables for Aerial and Underground use

Railway, Feeder and Trolley Wire

Weatherproof Magnet and Rubber Covered Wires and Cables

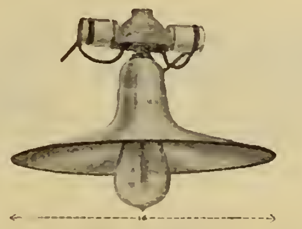
Incandescent and Flexible Cords

Eugene F. Phillips Electrical Works, Limited

MONTREAL - - CANADA

Branches: Halifax, Toronto, Winnipeg, Vancouver

Cat. No. 870
Rosette



Cat. No. 802
Streetlite

Cat. No. 59480
Key Socket

SAFETY
is the
FIRST
Consideration in Building
BENJAMIN DEVICES

Whether It Is a
RECEPTACLE SOCKET
REFLECTOR FITTING
or WIRING DEVICE
the factor of safety is first considered.

BENJAMIN PRODUCTS
are
SAFETY PRODUCTS

"BUY BENJAMIN"
MADE IN CANADA
FROM YOUR JOBBER

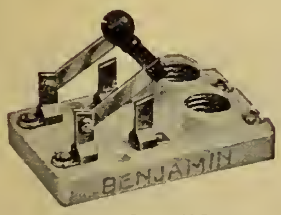
Benjamin Electric Mfg. Co.,
of Canada, Limited
Toronto - - Ont.

Cat. No. 1105
Floor Box

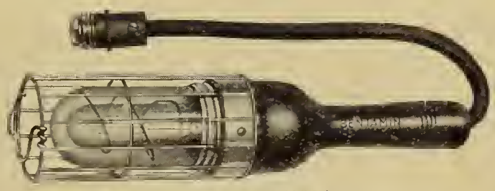
Cat. No. 59275
Receptacle

Cat. No. 61317
Porcelain Key Socket

Cat. No. 597
Angle Pull Socket



Cat. No. 1695
Switch and Cutout



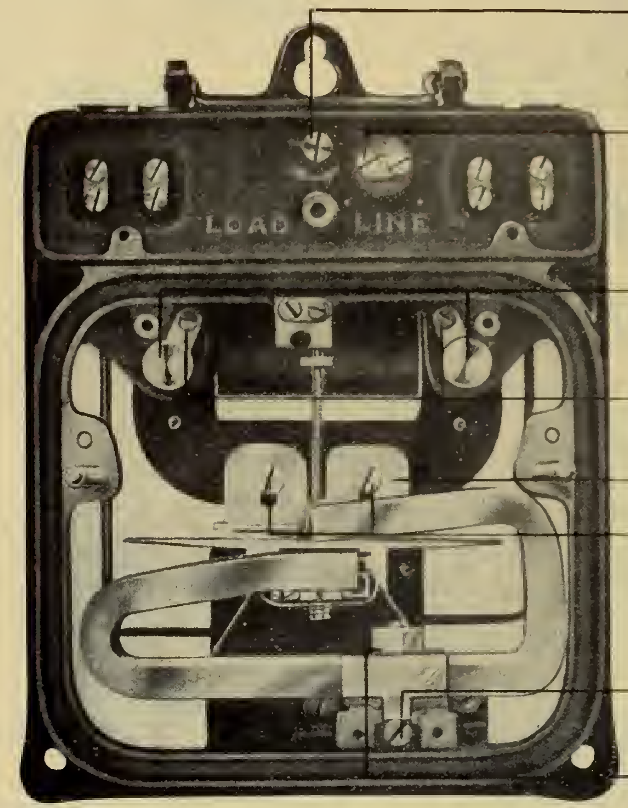
Cat. No. 260VP
Portable

Cat. No. 5031
Fitting

FERRANTI

Can you beat this for easy accessiblity to All Adjustments?

A peep at the inside of our Type "C" meter (Front View)



Clamping Disc – Turn in direction of arrow to unclamp the disc.

Testing. – For testing a number of Meters in series, disconnect link and connect potential lead here.

Low Load Adjustment. — Turn the Left hand Screw IN or the Right-hand Screw OUT to speed up on low load.

Tighten here to lock Adjustment.

Inductive Load Adjustment. Raise the Copper Lagging Coil to increase the speed on Inductive load.

Tighten here to fix coil.

Full Load Adjustment. – Screw Magnet inwards here to speed up

Tighten here to lock Adjustment.

POINTS WORTHY OF NOTE:—

Each part is removable independent of the other.
Low load adjustment—this system insures a much closer adjustment than can be obtained in any other meter.
Magnet or Full Load adjustment—note the rigidity of this arrangement preventing any possibility for a change in its position.
Spring seated saphire jewels (protected against damage in handling of meter by clamping-disc) are used. All friction is eliminated by use of lining adjustment for top bearing.
Send in a trial order and realize the advantages of these points for yourself.

EVERYTHING IN METERS

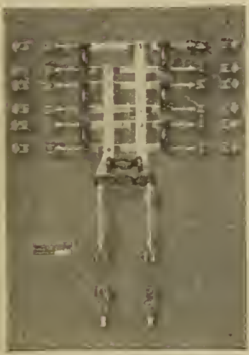
FERRANTI ELECTRICAL COMPANY OF CANADA
LIMITED

90 Sherbourne St.
TORONTO

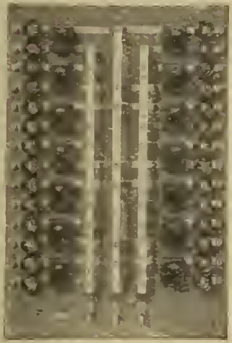
Farmer's Advocate Bldg.
WINNIPEG

Panel Boards and Cabinets

**That Embody Advanced Structural Principles.
Material and Workmanship the Best.**



Type A Panel



Type H Panel

OUR line of Panel Boards includes four distinct types, each made in single and double branch forms, with mains carrying lugs only, fuses, fuseless knife switch, and fused knife switch for 2 to 2 and 3 to 2 wire systems. Three to 2 wire Panel Boards are made in convertible form as well as the standard construction.

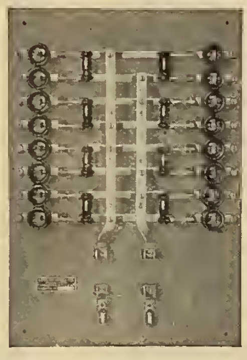
Type "A" Panels [125 and 250 volts]—Branches arranged for enclosed fuses and with or without knife switches.

Type "D" Panels [125 volts] — Branches arranged for plug fuses and with or without knife switches.

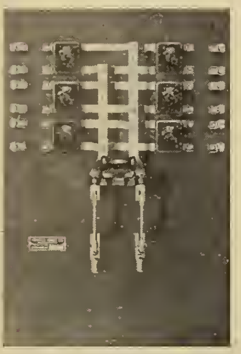
Type "F" Panels [125 and 250 volts] — Branches arranged for enclosed fuses and snap switches.

Type "H" Panels [125 volts]—Branches arranged for plug fuses and with snap switches.

Our designs in Cabinets embrace fifteen types—all steel, steel and wood combined and wood with slate lining, either for flush or surface mounting and with side or back gutters, also without gutter.

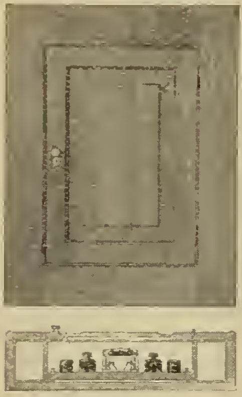


Type D Panel

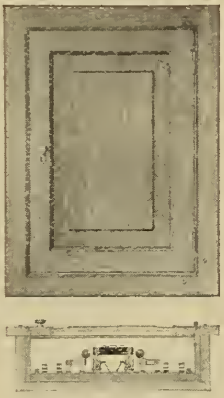


Type F Panel

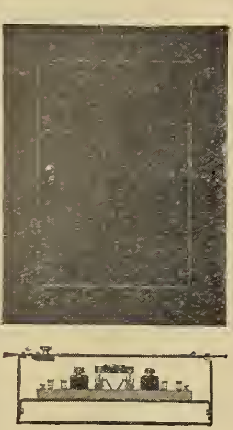
Type M Cabinet



Type DFP Cabinet



Type ESQ Cabinet



Type CL Cabinet

If your dealer does not stock them, write us.
" Panels and Cabinets," Bulletin No. 1 sent free upon request.

Crouse-Hinds Co. of Canada, Ltd.

Main Office and Works:

Toronto, Ontario, Canada

Kindly send me free copy of Bulletin No. 101.
Name..
City..
Prov...
21013

Duncan Quality

This is the goal of every process in the manufacture of our products—it's a habit. It applies to every line of our

Electrical Supplies

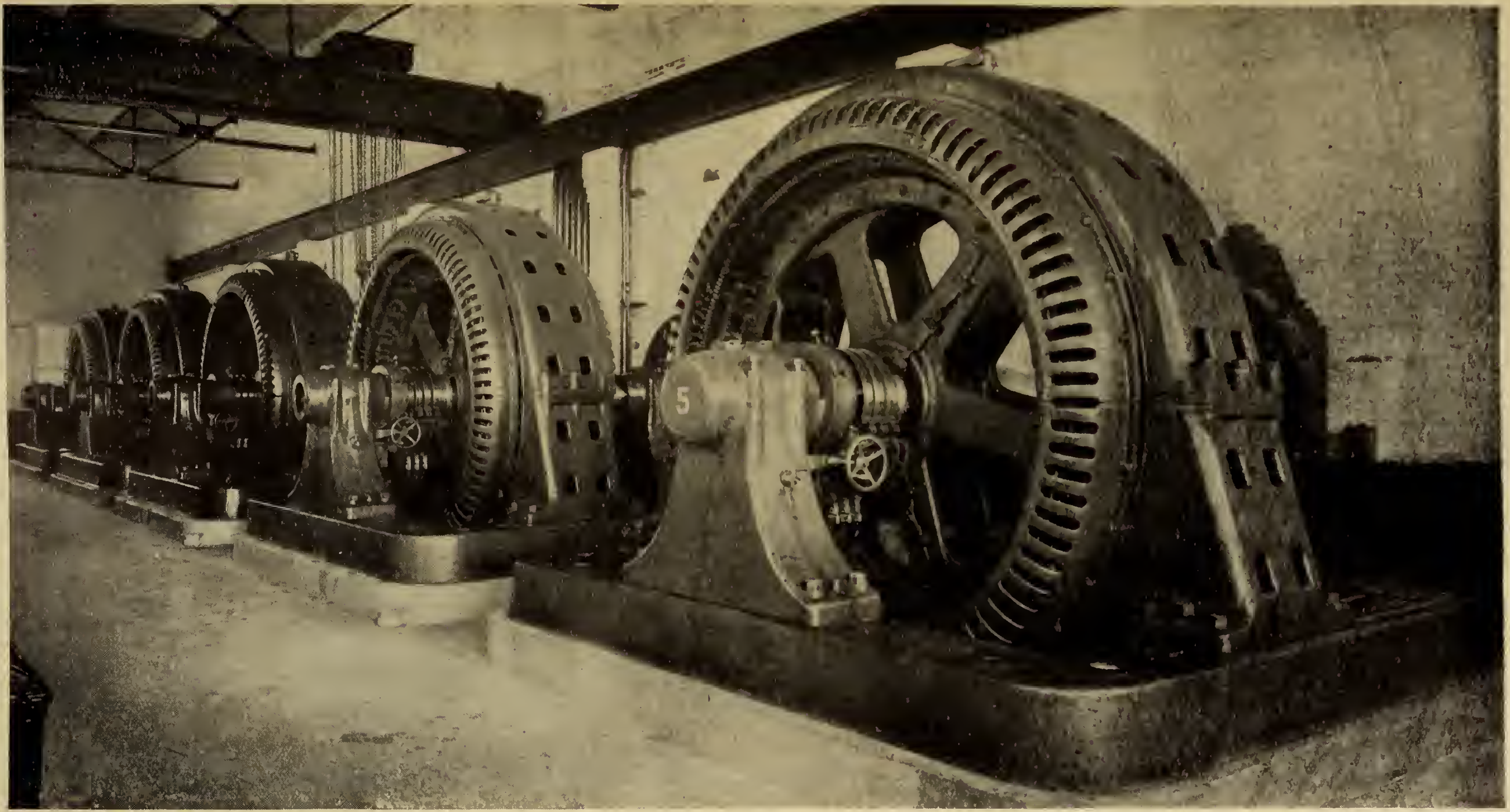
TRADE DUNCAN MARK

There's **your** guarantee, —the trademark which we back up all along the line.

It stands for the best of raw materials, the highest grade of workmanship and a rigid inspection before shipment.

Order through your jobber.

The
Duncan Electrical Co.
Limited
MONTREAL



The largest motor installation in Canada—Five 2,000 h.p., 12,000 volt, 25 cycle, 3 phase, 246 r. p. m. Swedish General Electric induction motors just installed in the mills of the Ontario Paper Company, Thorold, Ont.

THE SWEDISH GENERAL ELECTRIC, LIMITED

Head Office, TORONTO

Branch Offices: MONTREAL

General Supplies Ltd., CALGARY, ALTA.

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A GALVADUCT Building
Toronto Stock Exchange

GALVADUCT

"GALVADUCT"

The most perfect interior construction conduit on the market.
Recognized as the standard of high quality.

Always specify Galvaduct or Loricated

"LORICATED"

A high-class interior construction conduit of the enamelled type, proof against acid or other corrosive agents.

If your jobber cannot supply you—write us

LORICATED

Conduits Company Limited

Toronto - Montreal

The Electrical Apparatus Co., Limited

Vanxhall Works, South Lambert Road, LONDON, ENGLAND

Contractors to the British Government

manufacture

Switch and Motor Control Gear

for all industrial uses both for A.C. and D.C.
satisfying the most stringent specifications of

British Manufacture Throughout.

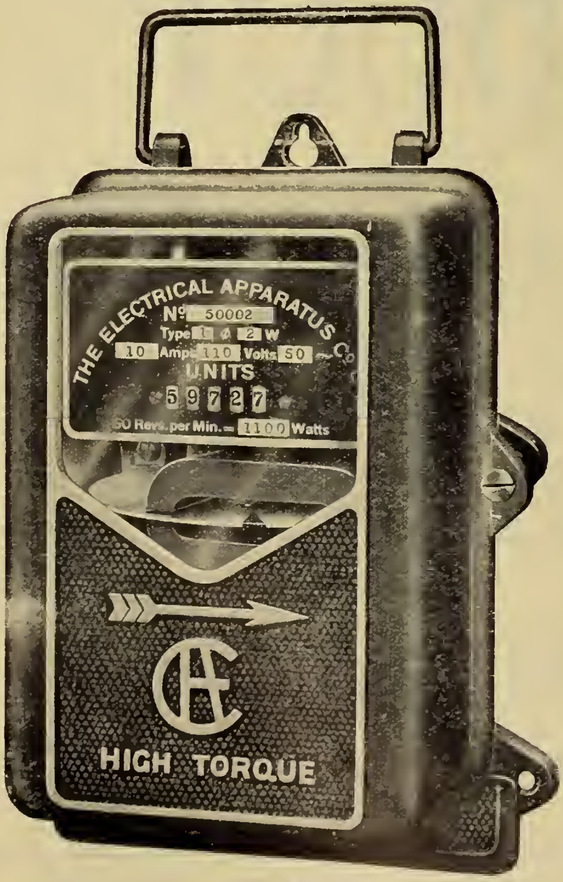
All classes of D.C. Motor Control Gear, Hand operated or Automatic Auto-transformer Starters, Star-Delta Starters, Rotor Starters and Controllers, either Air Cooled or Oil-Immersed.

also

The E. A. C. High Torque Single Phase

House Service

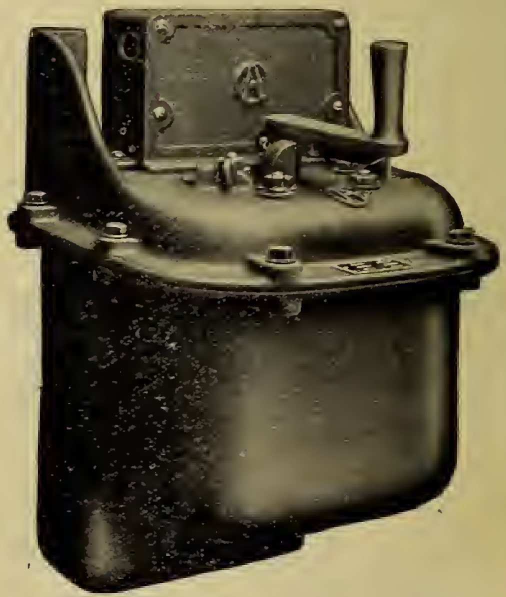
Meter



Clock or cyclometer dials supplied as required

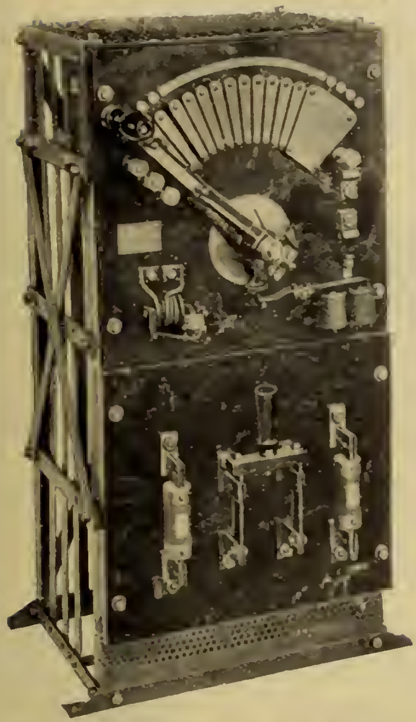
a distinguishing characteristic of which is the **Wide Range** over which the **Voltage, Periodicity Load and Power Factor** may be varied **without affecting its accuracy.**

Applications invited for Local Representation



Oil-Immersed Auto-transformer Starter

CUTLER-HAMMER



Floor Type Regulating Panel with Main Line Knife Switch and Fuses. No voltage and overload release.

Fan Regulators

of Every Capacity

used on ventilating fan and blower systems are included in the standard line of Cutler-Hammer regulators.

Speed regulation is accomplished by means of armature or shunt field resistance, or by a combination of armature and shunt field resistance. Both floor and wall types are made.

Floor type universal regulators having main line knife switch and fuses, are arranged with the regulating handle above the switch for convenience in operating. Wall type universal regulators have the regulating panel below the switch and fuses for the same reason.

Multiple Switch Types

For Heavy Duty and for Large Motors

Speed regulators of the multiple switch type are used with large motors and with motors of moderate capacities when the starting or operating conditions are severe.

The heavy armature currents are handled by the quick make-and-break switches without danger of destructive arcing.

If you have a fan control problem now—put it up to Cutler-Hammer. It costs you nothing to get the opinion of an engineering department that has specialized in motor control problems for twenty years.

Write for Fan Regulator Booklet which contains Bulletins on D. C. and A. C. Regulators.

Cutler-Hammer AUTOMATIC FAN CONTROLLERS

are made for use in connection with ventilating systems in

Court Houses, Libraries, Hotels, Theatres, Hospitals, Apartment Buildings, Schools, Halls, Churches.

As an instance take the case of the County Court House, New York City. Thirteen motor-driven fans are installed in the attic, each fan supplying air to one or more court rooms and anti-rooms. The controllers located adjacent to the fans are operated from the different rooms by means of combined push button and indicator stations.

Should more air be desired in any court room, the "fast" button of the station located in that room is depressed and the speed of the fan supplying that room is automatically increased. while the indication of the increase appears on the indicator in the same room. Removal of the pressure on the button locks the control lever at any desired point and the fan continues to run at the speed indicated. Should less air be desired the "slow" button is depressed.

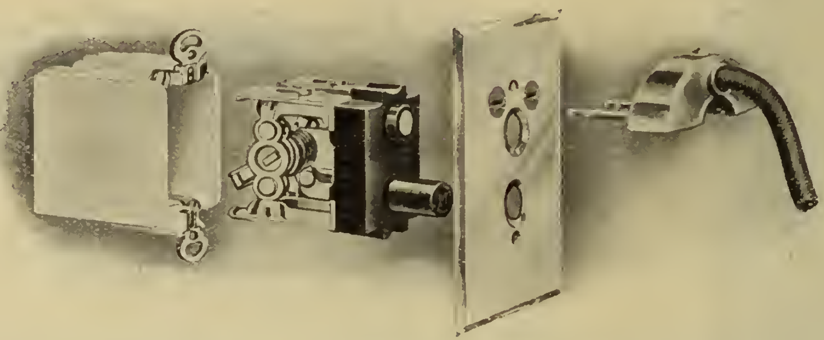
THE CUTLER-HAMMER MFG. CO. MILWAUKEE

NEW YORK: 50 Church Street **CHICAGO:** Peoples Gas Bldg. **PITTSBURG:** Farmers' Bank Bldg. **BOSTON:** Columbian Life Bldg.
PHILADELPHIA: 1201 Chestnut Street **CLEVELAND:** Schofield Building **CINCINNATI:** Fourth Nat'l Bank Bldg.
PACIFIC COAST AGENT: H. B. Squires Co., 579 Howard St., SAN FRANCISCO, San Fernando Bldg., LOS ANGELES and Morgan Building, PORTLAND, ORE.

TRADE METROPOLITAN ELECTRIC MFG CO. MARK

Panelboards, Switchboards, Knife Switches, Detachable Mechanism Flush Switches and Receptacles.

One Contact Box, One Face Plate with Renewable, Interchangeable Mechanism and Receptacle Plugs.



Metropolitan Detachable Mechanism Combined Switch and Receptacle.

Send us your specifications, our price is right, and delivery the best.

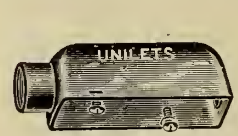
CANADIAN AGENTS:

ECONOMY ELECTRIC CO.

Bank of Hamilton Building **Yonge and Gould Sts., TORONTO**

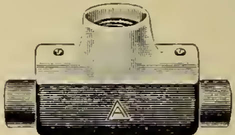
"UNILETS"

are drawn from steel and possess many merits which are an absolute necessity for up-to-date conduit work. For durability, neatness, space for making wire connections, "Unilets" meet all requirements. "UNILETS" are mechanically right. The conduit is steel, why not the fitting? Try them on your next job. Copy of booklet "UNILETS" mailed on request.

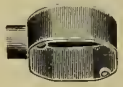


Cat. No. 9001—Rectangular Unilet.

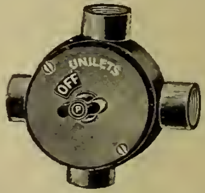
Cat. No. 9202—Rectangular Unilet.



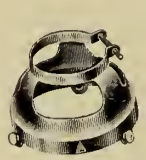
Type No. 2—Rectangular Unilet. Cat. No. 9002 with No. 7650 Receptacle.



Type No. 1 Octagon Unilet. Cat. No. 7501.



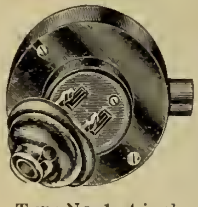
Type No. 4— Round Unilet with enclosed Snap Switch.



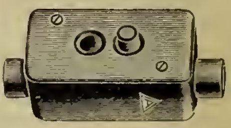
Cat. No. 7322—Shade Holder

Cat. No. 6906 Vapor-Proof Unilet.

Combination Plug Receptacle and Push Button Switch Unilet—Hubbell Plug Receptacle and Arrow E Push Button Switch Attached.



Type No. 1—4-inch Round Unilet with Two-phase Receptacle Attached.



Type No. 2 – Switch Unilet. Cat. No. 6501. with Push Button Switch Attached.

ADDRESS DEPT. "D" FOR COPY OF BOOKLET

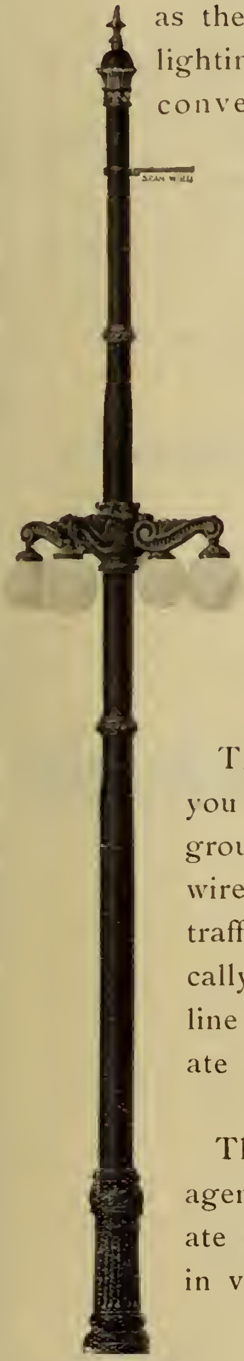
APPLETON ELECTRIC COMPANY

Main Office and Factory CHICAGO 212-214 N. Jefferson Street

For Sale in Canada by

The Mainer Electric Co., Ltd., Winnipeg Marshall-Wells Co., Ltd., Winnipeg Chapman & Walker Ltd., Toronto

Use the Railway's Trolley Poles



as the basis of your new street lighting system. You can easily convert them into attractive Mazda Lamp Standards or arc lamp supports by use of

'ERECO Combination Railway Lighting Pole Fixtures

This system, besides saving you the expense of underground construction, gets the wires up out of the way of traffic, where they are practically unnoticeable and the curb line is not crowded with separate lighting standards.

The progressive railway management will gladly co-operate with you with this object in view.

Design No. 10015.

Electric Railway Equipment Co.

Cincinnati, Ohio

Designers **Manufacturers**

Canadian Representatives:

Dawson & Co., Limited, Montreal, Winnipeg

N. Y. Office, 30 Church St., Hudson Terminal Bldg.

Butler Bros *Chicago*

Another Mammoth Firm Installs the Eye Comfort Lighting System.

Indirect Illumination is the light of the future. It is here to stay.

Many contractors and supply men realize this opportunity and are making big profits as a result. Central Stations are quick to grasp its advantages.

Which is then the most efficient and most economical system? Which is scientifically designed by engineers to produce perfect lighting, and which has been marketed merely to get some of the profits to be made by selling unscientific and inefficient equipment to a public who has not the knowledge to judge intelligently?

Which system shall **you** advocate?

We say to you:—

> That the Eye Comfort Lighting System was installed by the Curtis Publishing Company at Philadelphia (1,000 fixtures) after a sixteen months' investigation. Armour & Company equipped their entire five-storey building (900 fixtures) after eight months of testing. Butler Brothers, shown above, light their offices and sample rooms (1,700 fixtures). Boys High School, New Orleans, is installing 1,200 fixtures. The world's largest men's wear store, The Hub, Chicago, is lighted by it throughout (eight stories). The International Harvester Co. has installed 350 fixtures; Sears Roebuck & Co., 700; Montgomery, Ward & Co., 250; Goodyear Tire & Rubber Co., 385 fixtures at Akron, besides thirty branches; and so on.

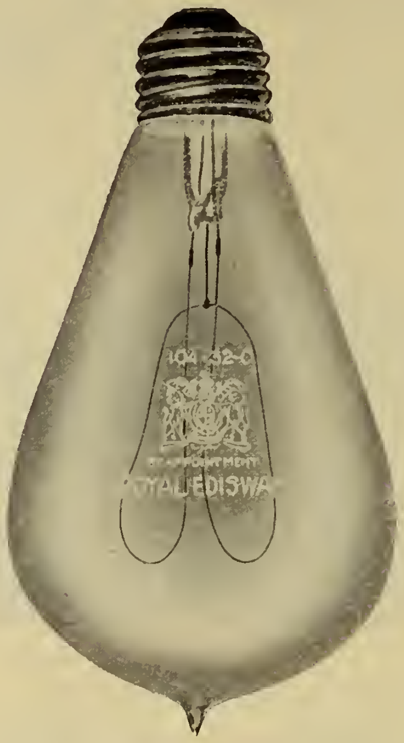
Millions of capital says "it is the best system, barring none!" This after exhaustive tests costing thousands and much time.

We cannot offer you stronger proof. We know of no more positive proof you can give your customers. Acquaint yourself with the Eye Comfort Lighting System. It is sold by Canadian jobbers. Ask for our data book and catalogue.

National X-Ray Reflector Co.

General Offices:
225 W. Jackson Blvd.
Chicago, Ill.

New York Office:
Eye Comfort Lighting Shop
4 W. 33rd. St.



No. 21 Bulb, 50 C.P

We are sole Canadian Agents for

"ROYAL EDISWAN"

CARBON FILAMENT LAMPS

In the manufacture of the "Royal Ediswan" Carbon Lamp, the makers have spared no effort to perfect a product of superior quality and maximum efficiency.

Those among your customers who prefer the carbon filament lamp will find the "Royal Ediswan" a satisfaction which comes only from a high-grade product.

Made in standard American bulbs, (also fancy bulbs) and built to standard specifications.

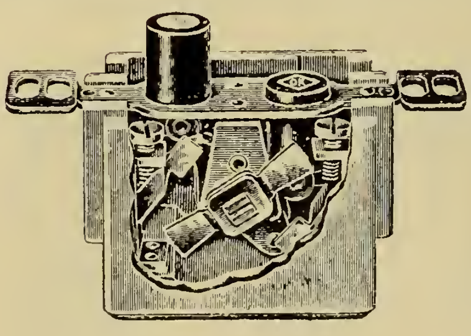
We are prepared to make prompt shipments on all orders—large or small.

Chapman & Walker, Limited

TORONTO 118-20 Richmond St. West ONTARIO
MONTREAL WINNIPEG VANCOUVER

If It's O. K. It's Allright

TRADE MARK



Best and brightest British Brand.

Push Button Switches (Flush type) arrange to fit standard switch box.

Each Switch packed separately in a cardboard box and complete with fixing screws and washers.

These Switches are made to last.

All O. K. material is labelled by the Underwriters, and tested by Canadian Engineers at the factory. Delivery from stock.

Write and ask for our O. K. catalogue.

CHAPMAN & WALKER, Limited

118-120 Richmond St. W., TORONTO, ONT.
VANCOUVER WINNIPEG MONTREAL

J-M FIBRE CONDUIT

"The Conduit You'll Eventually Use"

Points of interest to the consumer are saving in hauling, time in laying, ease of handling, perfect joints, true alignment and smooth interior.

Furnished with Bell or Straight Joints in four styles; Socket, Drive, Sleeve, Screw—with fittings to meet all conditions. Standard tubes 2 in. to 4 in. in diameter, Bell Joint 54 in., Straight Joint 60 in. long.

Write nearest Branch for samples, booklet and prices.

Shipping J-M Fibre Conduit

The Canadian H. W. Johns-Manville Co., Limited

MANUFACTURERS OF SERVICE, SUBWAY AND TRANSFORMER BOXES: FUSES; LINE MATERIAL; INSULATING MATERIALS; FIBRE CONDUIT; FIREPROOF WOOD; FRICTION TAPES; DRY BATTERIES; LIGHTING SYSTEMS; ETC.

TORONTO MONTREAL TRADE ASBESTOS MARK WINNIPEG VANCOUVER

1824

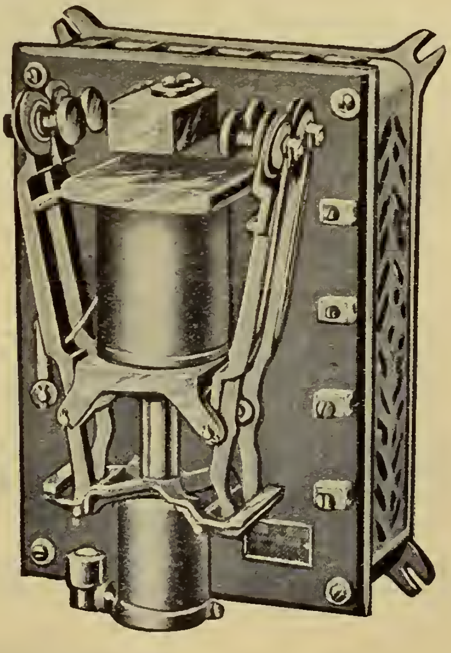
SUNDH SOLENOID MOTOR STARTERS

Compact and reliable starter for Direct Current. No sliding contacts.

The advantages of this type of construction are not only simplicity and easy replacement of wearing parts, but also the elimination of sliding contacts which cause trouble due to arcing and consequent sticking of the moving member.

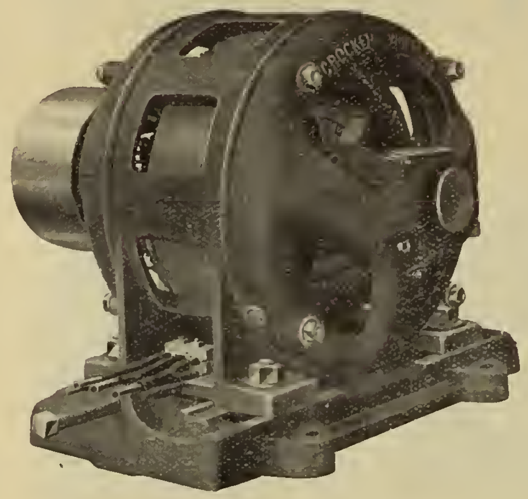
The construction of the Sundh Automatic Starter is compact and simple, consisting of a solenoid, a plunger with retarding dash-pot, and two or more levers hinged to the lower pole-piece of the solenoid.

Send for illustrated Catalogue on Electrical Controlling Devices



The upper ends of the levers carry the contacts. The levers are controlled by their lower ends passing through a frame which is attached to the bottom of the plunger. The contacts are of copper and carbon, and all wearing parts are accessible and easily replaced. For heavy duty the final contact is made by a laminated copper brush. This copper brush, however, does not cut out any resistance, but merely short-circuits the carbon contacts which do cut out the resistance.

Sundh Electric Company - - New York, U.S.A.



The

Design of

CROCKER-WHEELER

Induction Motors

includes

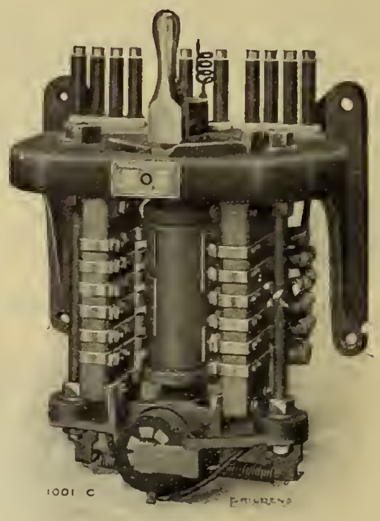
Heavy Shafts

Large Journals

Ideal End Ring Construction

High Power Factor

Excellent Efficiency



Our
Starter
with
Oil Immersed
No Voltage
Release

THE CANADIAN
CROCKER-WHEELER CO.
LIMITED

MANUFACTURERS AND ELECTRICAL ENGINEERS

Head Office and Works
ST. CATHARINES

District Offices
MONTREAL, TORONTO, VANCOUVER

You Eliminate Needless Risk

when you install STANDARD Rubber Insulated Wire in that building of yours Its guarantee of safety consists of many years of unusually successful and dependable service and in the fact that it is specified and used by architects, engineers and contractors of many buildings of international importance, one of which is shown below.

Ft. Garry Hotel, Winnipeg, Man.
Architects:
Ross & McDonald, Montreal, Que.
El. Contractors:
L. H. Nielsen Co. Inc.
Pittsburgh, Pa.

STANDARD Rubber Insulated Wire

stands for maximum quality which means the greatest economy and durability. It exceeds National Electric Code requirements to a degree that entitles it to be considered as a separate and **higher** standard of excellence.

When in need of rubber insulated wire it will pay you to get prices of STANDARD wire before placing your order.

Our nearest office will give you complete information promptly.

Standard Underground Cable Co.
of Canada, Limited

Montreal, Que.
Boston, Mass.

Hamilton, Ont.

Winnipeg, Man.
Seattle, Wash.

Manufacturers of Electric Wires and Cables of all kinds, all sizes, for all services, also Cable Terminals, Junction Boxes, etc.

I-T-E

CIRCUIT BREAKER

Cutter standers are the requirements of the Consulting Engineer.

Our methods make the special circuit breaker of to-day, the standard circuit breaker of to-morrow.

Our customers are the largest and shrewdest buyers in the country.

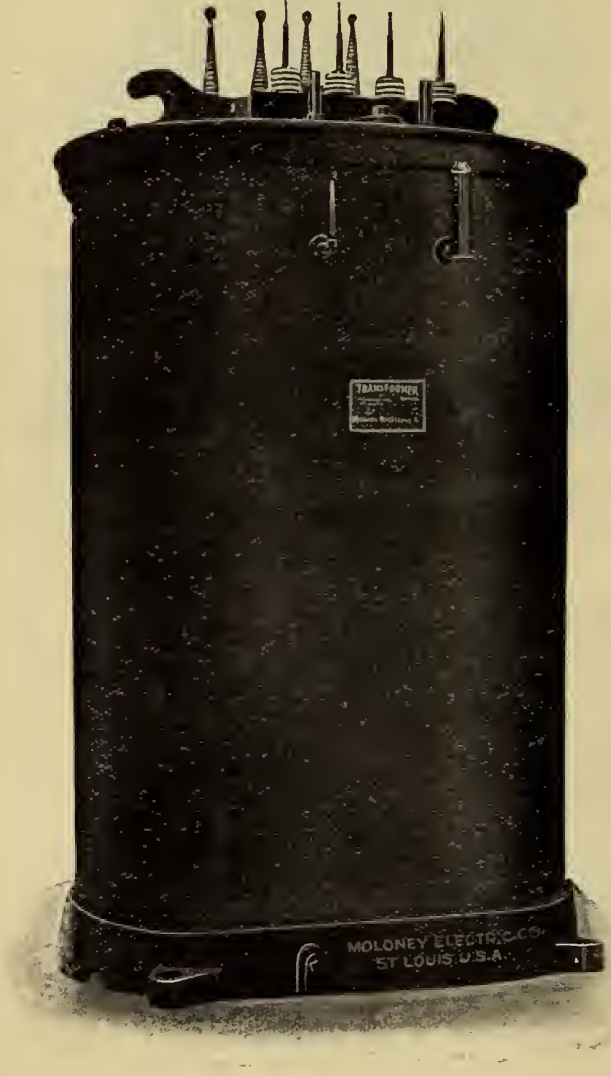
They pay more for our apparatus and THEY KNOW WHY.

Our competitors know why too.

THE CUTTER COMPANY Philadelphia

The
Best
In
1897

Moloney Efficiency



A PERFECT transformer should take your current at one voltage and deliver it (100%) another voltage. No transformer made will do this as the core and copper losses consume some energy. The special core type construction of Moloney High Efficiency transformers and the non-ageing Silicon Alloy Steel used in their manufacture reduces core loss to a minimum. Carrying capacity of the copper reduces copper loss.

Moloney Transformers will save 20% of the cost of other good transformers, and in five years the cost of a new transformer.

Our Catalogue contains much valuable information

The
Best
In
1914

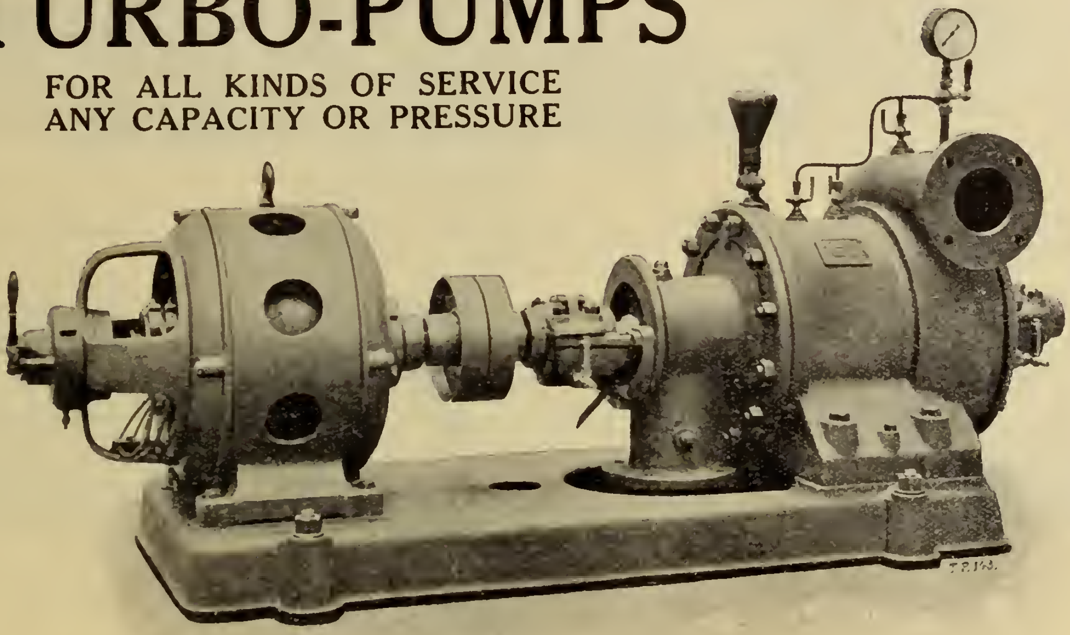
Canadian Moloney Electric
Company, Limited
WINDSOR, ONTARIO
Complete Stocks at **Windsor, Winnipeg, Vancouver**

TURBO-PUMPS

FOR ALL KINDS OF SERVICE
ANY CAPACITY OR PRESSURE

Highest Efficiency

Greatest Reliability

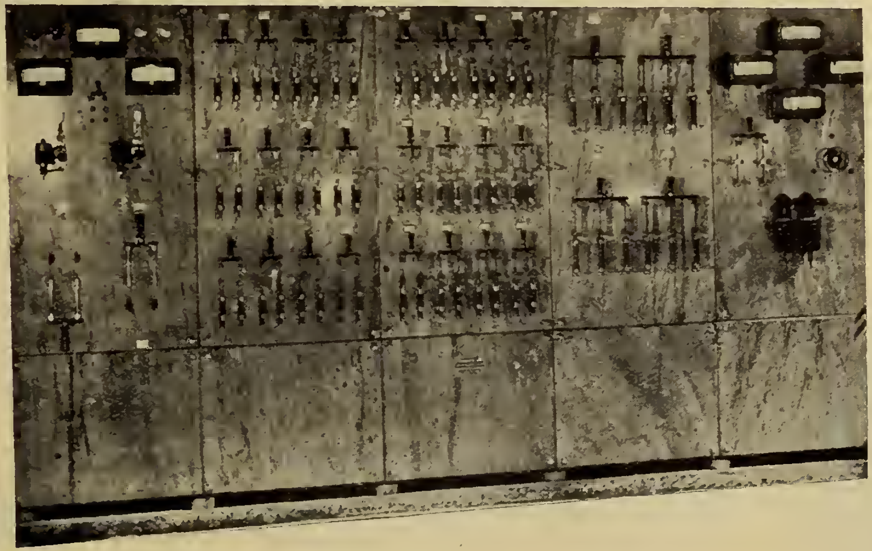


ESCHER WYSS & CO.

HEAD OFFICE FOR CANADA:
626-627 Coristine Bldg., Montreal, Que.

"DEVOE" MEANS QUALITY

Panels, Switches, Switch-Boards built to any specification.



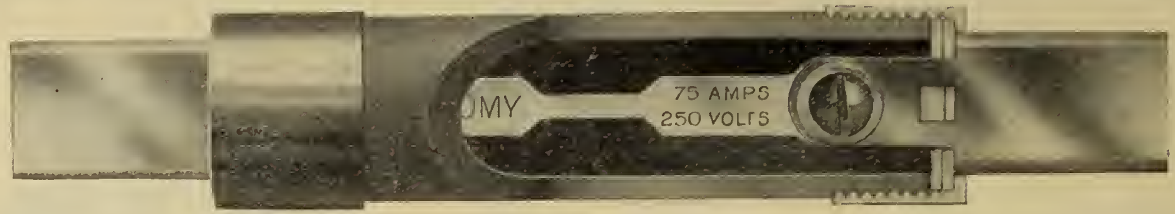
An examination of "DEVOE" Standard Panels, Switches and Switchboards will convince you they are the best made.

We specialize in Switch Boards.

THE DEVOE ELECTRIC SWITCH COMPANY

Office and Factory 157 Craig Street West, Montreal, Que.

Frank G. Scofield, Ontario Sales Representative, Lumsden Building, Toronto, Ontario



"Look for the Gray Shell"

Light and Power Companies, Large Corporations, Industrial Plants, Mining and Smelting Companies, Department Stores, Hotels, Office Buildings, Electric and Steam Railroads, Steamships, U. S. Government, and many other classes of users are **reducing fuse Maintenance expense over** 80 per cent by using

ECONOMY RENEWABLE FUSES

They use Economy Renewable Fuses for these reasons:

First, of course, because it provides a practical method of reducing the fuse maintenance expense more than 80%.
Second, because it is the only renewable fuse that is uniformly rated.
Third, because it is the only design so far produced that provides the desired electrical characteristics.
Fourth, because all capacities of renewal elements are readily available, making large fuse stocks unnecessary.
Fifth, because they never vent fire or hold a sustained arc and are absolutely safe.
Sixth, because they meet the performance specifications governing the use of such devices.

Special Announcement!

Two Economy Renewal Elements are now furnished (without charge) with each Economy Fuse. Now YOU figure what fuse is the cheapest not only to buy but also to maintain.

Write for Bulletin, Prices and Discounts

Economy Fuse & Mfg. Co. of Canada, Limited

Herald Building, Montreal

ECONOMY Renewable Fuses are sanctioned by the Canadian Fire Underwriters' Association.

DON'T LET LIGHTNING CRIPPLE YOUR SERVICE

The C-G-E Compression Chamber Lightning Arrester has proved its effectiveness in three seasons of service.

An ingenious combination of small gaps and antennae causes the arrester to discharge before the lightning voltage becomes dangerous.

A low series resistance permits a free and rapid discharge.

The large number of gaps, made possible by the use of antennae, and the cooling effect of the compression chambers positively ensure prompt cutting off of the generator current following the lightning discharge.

The compression chamber arrester can not ground or short circuit the lines.

Efficient, light, compact, weather and fireproof, easy to install, requiring no attention, and low-priced, the compression chamber arrester solves the problem of economically and reliably protecting pole transformers and thus preventing interruption to service from lightning disturbances.

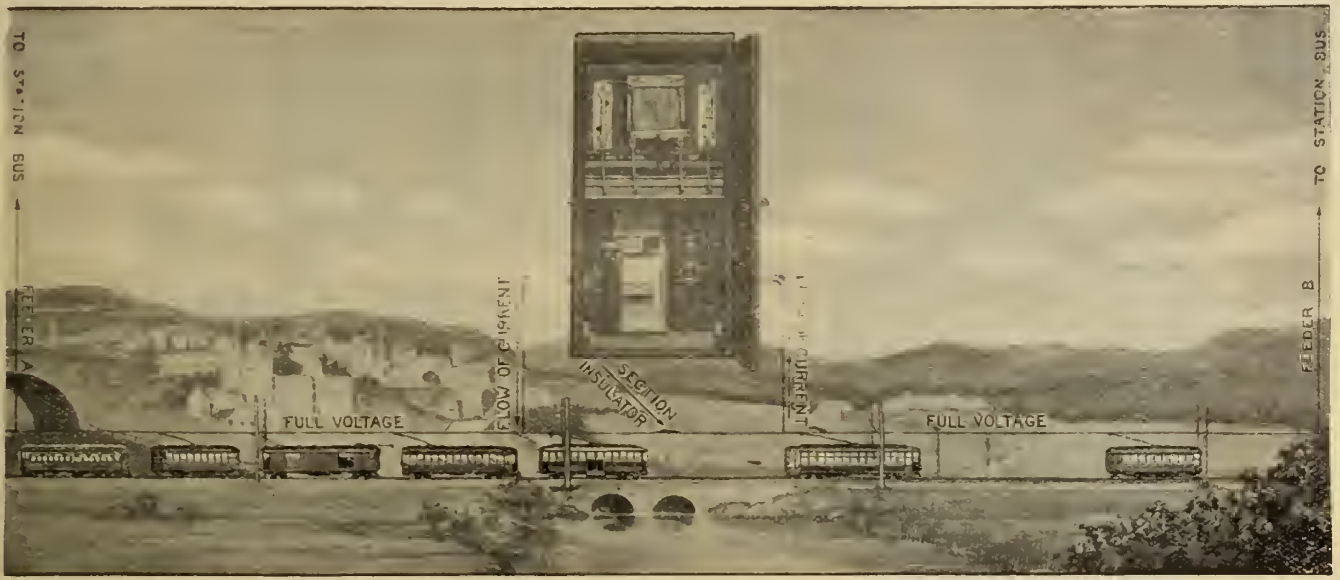
For full information write to our

Head Office: Toronto. District Sales Offices: Montreal, Halifax, Ottawa, Cobalt, Porcupine, Fort William, Winnipeg, Regina, Saskatoon, Calgary, Edmonton, Nelson, Vancouver, Victoria, Prince Rupert.

CANADIAN GENERAL ELECTRIC CO.

LIMITED

Manufacturers of Electrical Apparatus and Supplies for Railway, Light and Power Purposes



AUTOMATIC SECTIONALIZING SWITCH

C-G-E Automatic Sectionalizing Switches will equalize the voltage on all sections of a trolley line, thus taking care of overload conditions with a consequent improvement in service.

In systems where these switches have been installed, exchange current readings as high as 600 and 700 amperes have been recorded during rush hours with a resultant increase in potential of from 100 to 150 volts.

C-G-E Sectionalizing Switches are highly recommended to those wishing to improve their operating conditions without the large outlay for feeder copper generally necessary.

Write our specialists for further information

CANADIAN GENERAL ELECTRIC CO.

LIMITED

Manufacturers of Electrical Apparatus and Supplies
for Railway, Light and Power Purposes

Head Office: Toronto. District Sales Offices: Montreal, Halifax, Ottawa, Cobalt, Porcupine, Fort William, Winnipeg, Regina, Saskatoon, Calgary, Edmonton, Nelson, Vancouver, Victoria, Prince Rupert

Our Improved Type "K" Meter

In the past this type of meter has won a reputation among electrical engineers and central station men for its practical design and accuracy of calibration. We show it here with its improved magnet supports and light load adjustment.

IT'S A Packard METER

Large Stocks Carried at

St. Catharines and Winnipeg; St. John Railway Co., St. John, N. B.; General Supplies Limited, Calgary, Alta.; Rudel-Belnap Machinery Co., Canadian Express Building, Montreal, P.Q.

The Packard Electric Co., Limited

Factory at
St. Catharines, Ont.

General Sales Office
Traders Bank Building,
TORONTO

N. W. Office and Warerooms
WINNIPEG

KIMBLE

VARIABLE SPEED MOTORS

are preferred by

Discriminating Motor Users

BECAUSE

They give varying speeds (every speed from 500 to 2,000 R.P.M.) without the use of resistances which are wasteful of power.

They start, stop, reverse and change speed by a single movement of the lever, without disturbing the circuit or damaging the windings.

They can be instantly reversed from full speed forward to full speed backward without damage. This feature makes them indestructible and fool proof.

The entire control of the motor including start, speed changes, stop and reverse, is secured by a single lever. This lever is a part of the motor itself. When the lever is on its "off point" no current is in the motor for the lever shuts it off the same as an outside switch. Nothing could be more simple and effective.

They are very easily installed, the smaller sizes requiring only two wires direct from the plug to the terminals of the motor. All except the larger sizes can, with perfect results be connected up to any incandescent light sockets.

KIMBLE SINGLE PHASE VARIABLE SPEED MOTORS start with a full load torque. This insures their using no more current in starting than is used at full load. In the **KIMBLE** motor a given speed consumes only a given current, half that speed, half the current—with none of the current wasted in resistance coils, or other unnecessary attachments. Power waste is thereby reduced to the very minimum.

THEY ARE THE ACME OF PERFECTION

Write for Descriptive Literature

The Mainer Electric Company, Limited

WINNIPEG, MAN. - EDMONTON, ALTA.

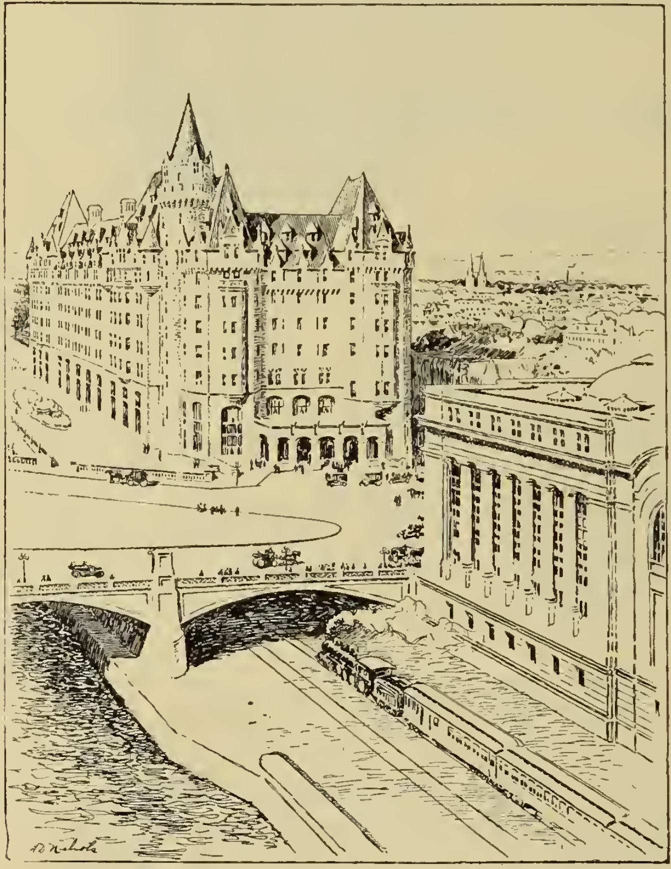
The Largest Electrical Supply House in the West

Across Canada with the

IMPERIAL WIRE & CABLE CO.

LIMITED

Toronto - MONTREAL - Winnipeg



Second of a series of advertisements showing buildings of national importance which have been wired with Imperial Wire & Cable Co.'s, Limited, wires.

This picture shows
Chateau Laurier
and
Grand Trunk Central
Station, Ottawa

These buildings were wired throughout with "ADANAC" Rubber Insulated Wire

Architects: Ross & McFarlane, Montreal.
Engineers: Westinghouse, Church, Kerr & Co., New York.
Electrical Contractors: Western Electric Co., New York.

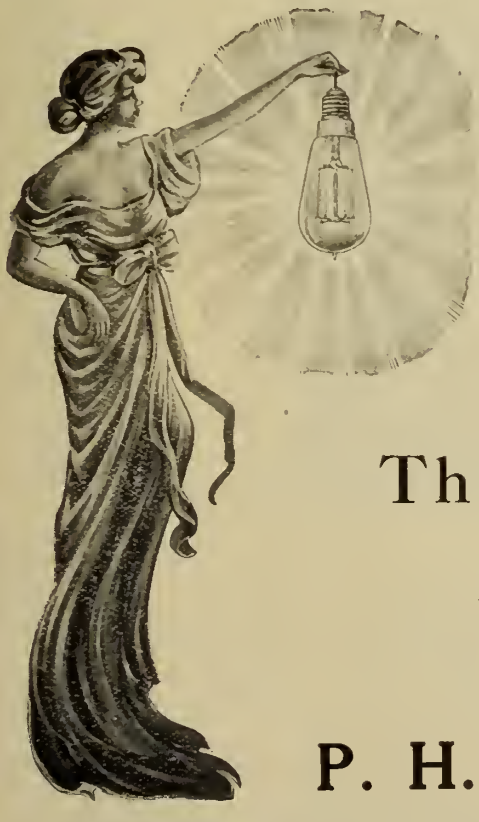
Address our nearest office, Montreal, Toronto, Winnipeg

Alberta and British Columbia enquiries may be addressed to our Sales Agents, Northern Electric & Manufacturing Co., Limited, Calgary and Vancouver.

G. M. Gest

Conduit
Engineer & Contractor

503 Power Building, Montreal, Can.



NEWTYPE
BERGMANN
LAMPS
(*Tungsten Filament*)

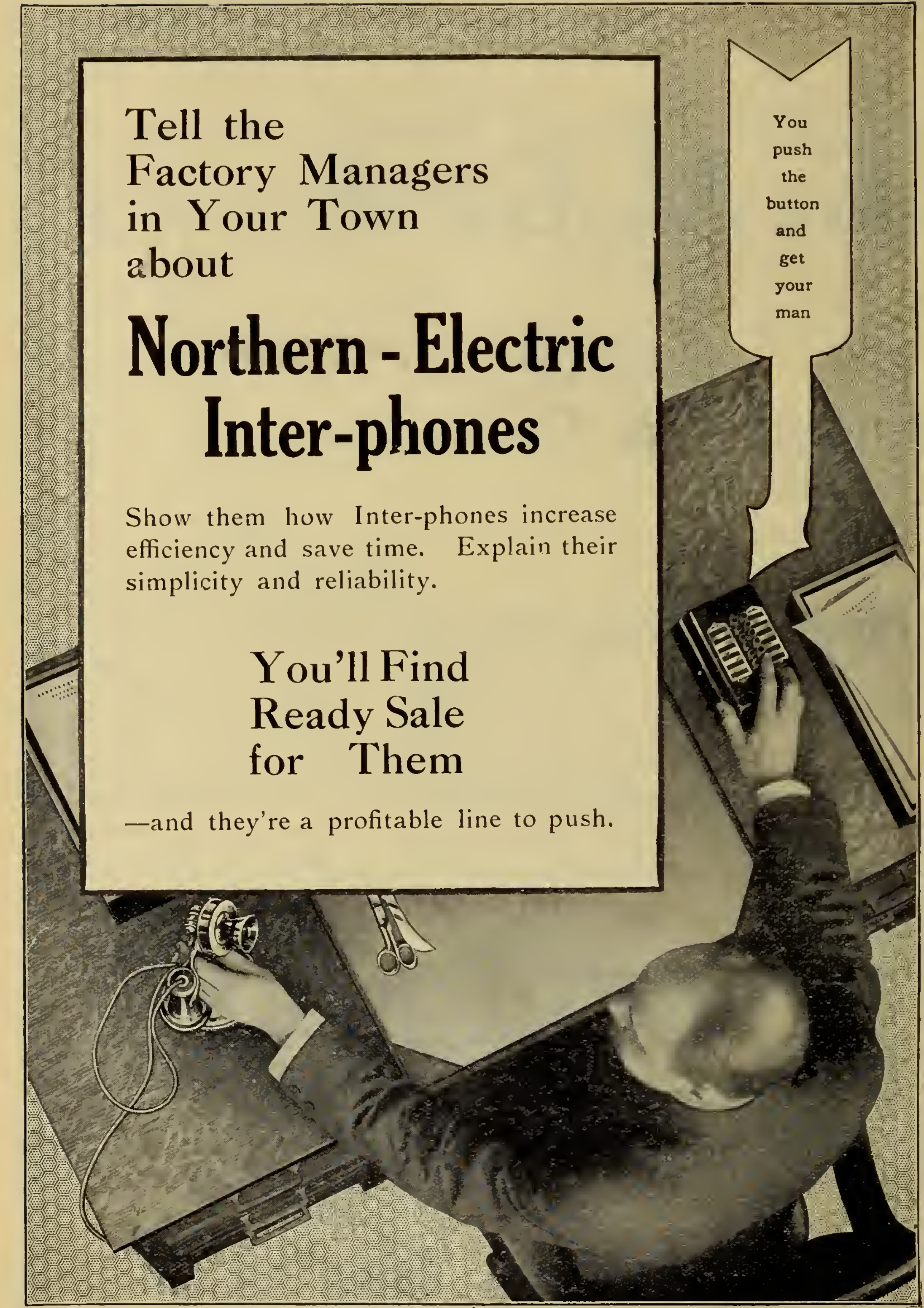
The Unbreakable Kind

Are Now Ready for Delivery

We guarantee delivery to you in good condition

EXCLUSIVE CANADIAN DISTRIBUTORS
P. H. KLEIN CO., LIMITED
23-25 DOWD STREET,
MONTREAL, P.Q.

LIVE AGENTS WANTED ALL OVER CANADA



Tell the
Factory Managers
in Your Town
about

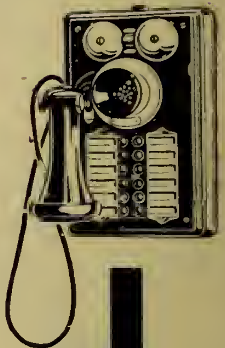
Northern - Electric Inter-phones

Show them how Inter-phones increase efficiency and save time. Explain their simplicity and reliability.

You'll Find
Ready Sale
for Them

—and they're a profitable line to push.

You push the button and get your man



Write for our Dealer Inter-phone Proposition

THE Northern-Electric
AND MANUFACTURING CO. LIMITED
Makers of the Nation's Telephones

MONTREAL
HALIFAX
TORONTO

WINNIPEG
REGINA
CALGARY

EDMONTON
VANCOUVER
VICTORIA

Your Customers Will Be Interested

To Know That

Northern Light

MAZDA LAMPS

Cut Down the Cost of Light Bills

Northern Light Mazda Lamps give 25% MORE LIGHT and consume 25% LESS CURRENT than Carbon Lamps.

Your Sales on This Profitable Line Will be Increased

if you explain the fact to your trade.

The attractive cartons in which Northern Lights are packed will brighten up your shelves. They will prove automatic salesmen if prominently displayed in your store.

Northern Lights range in rating from 15 watts to 500 watts.

Large stocks are carried at all our houses. Your order will receive prompt attention.

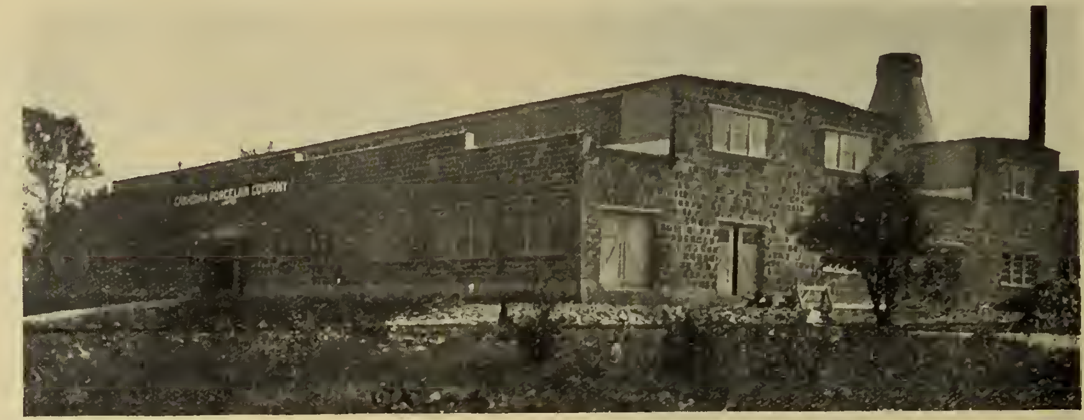
Address it to our nearest house.

THE Northern Electric AND MANUFACTURING CO. LIMITED

Montreal Halifax Toronto Winnipeg
Regina Calgary Edmonton Vancouver Victoria

The Canadian Porcelain Company, Limited

HAMILTON, - ONTARIO



Cut shows new plant recently completed and now in operation.

We wish to announce our readiness to tender on your insulator requirements.

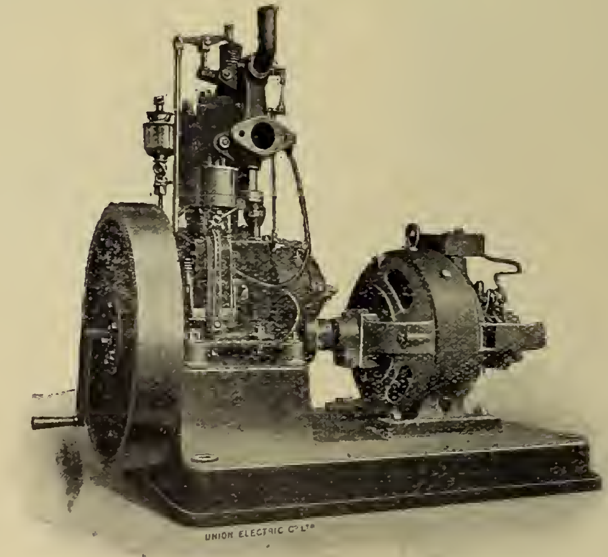
Our plant is modern in every respect embodying the best European and American practice in arrangement and methods.

Our plant is in charge of experienced insulator specialists.

"UNION" Dynamos and Motors

For All Industrial Purposes

Estimates given for all special designs of motor and engine driven generator sets.



Direct Connected Gasoline Generating Set

Write for our motor stock list published monthly and take advantage of our prompt deliveries.

Canadian Union Electric Co., Limited
Head Office: 30 Wellington St., West, Toronto
Also at 9 St. Nicholas St., Montreal

Represented in Winnipeg by:
The Mainer Electric Co., Limited
61-63 Albert St.

"AMERICAN"
Bituminized Fiber Conduit

For Underground Construction

7 Foot Lengths. 3/8 Inch Walls. 5/8 Inch Joints.
Absorption, 100 Hrs., 3/4 of 1%. Puncture Test, 50,000 V
Electrolysis-proof—Water-proof—Gas-proof.

Comparison of above figures with other types of Fiber Conduit will show the superiority of our product.

Interesting and Valuable Booklet "Underground Conduit Construction" free on request. Send for it.

American Conduit Co.

East Chicago, Ind., U. S. A. 140 Nassau St., N. Y. City

Distributors for Canada:
The Northern Electric & Mfg. Company, Limited, Montreal, Halifax
Toronto, Winnipeg, Regina, Calgary, Edmonton, Vancouver.

"LE CARBONE"

(Made in France)

Carbon Brushes

are acknowledged by all users to be "Something out of the ordinary."

They are the original carbon brush, and have led the field during the twenty years of progress since the inception of the industry.

"Le Carbone" product comprises a complete range of varying resistance brushes, from low to high conductivity.

Rougier Freres Inc.

63 Notre Dame, East
MONTREAL

"EVERSHEDS"
MEGGERS

The high range megger has proved to be an extremely useful instrument for the locating of insulator faults undiscoverable so far as ordinary means of inspection are concerned.

Tests made - - - have shown that the megger can be absolutely depended upon.

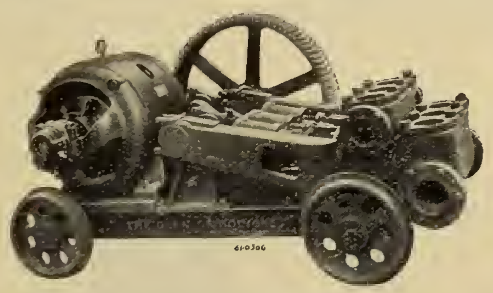
From Proceedings of the American Institute of Electrical Engineers of Feburary 1914, page 217.

Sole Canadian Agent

R. H. NICHOLS

Dineen Bldg. TORONTO

WAGNER SINGLE PHASE MOTORS



Wagner 15 horse-power Single-Phase Motor driving horizontal triplex single acting truck mine pump.

Self-starting under full load with no other device than a double pole switch.

Rugged and reliable. Probably not so low in first cost as some others but with them first cost is last cost. They do not add to their cost by expensive shutdowns of your plant.

¼ to 60 H.P. for all commercial frequencies and voltages.

Bulletin 10113

Wagner Electric Manufacturing Company
of Canada Limited—Montreal

27 Guardian Bldg., Montreal 1222 Traders' Bank Bldg., Toronto

Member of the Society for Electrical Development—Do it Electrically.

Improving Double Track Operation by Continuous Track Circuit Signaling

"G-R-O-W spells Grow. If you want to GROW Go Right On Working"—but, in the meantime, prepare for this growth of business. Under normal operating conditions upon double track, the time interval system, or dispatching systems are perhaps satisfactory, but what about abnormal conditions due to growth of traffic—where schedules are shortened and the number of trains increased? Such systems mean delay and decreased safety in direct proportion to the volume and speed of traffic.

The solution for growth in traffic is by installing G. R. S. Automatic Block Signals—the *Continuous Track Circuit* kind; they allow trains to be spaced more closely and a higher acceleration in getting under headway can be secured. Bear in mind that

Double Track Safety
and
Double Track Capacity
are both augmented by
G. R. S. Continuous Track Circuit Signals

Safety First

GRS **GENERAL RAILWAY SIGNAL COMPANY** GRS
OF CANADA, Limited

Office and Works
Lachine, Quebec

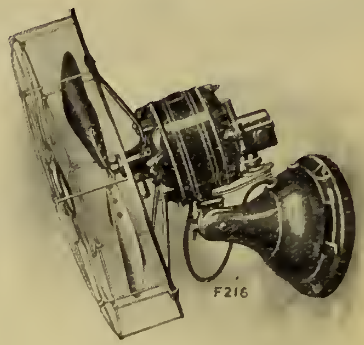
Branch Office
Winnipeg, Man

9115A

SAFETY FIRST
The Important Factor in Fare Collection

Satisfaction Guaranteed
Write for Catalog

Cleveland Fare Box Co.
5310 St. Clair Ave., Cleveland, Ohio



IT SELLS!

That's the first thing you want to know about a Fan.

And if it does that, it's reasonable to assume that it's quality, economy and consistent advertising that does it. These are big advantages—They're the things you want in the fans you sell. You find them in

Robbins & Myers "STANDARD" Fans

Write for Agency Proposition

Find out what we have to offer to dealers this season. Get started early—then you're sure of getting shipments on time. We're ready to do our part. Let us hear from you.

The
Robbins & Myers Co.
Springfield, Ohio

We also make a complete line of A. C. and D. C. Motors for all purposes.

Bound in Leather and just fits your vest pocket—the handiest little book you ever had and it's FREE.

A Free Ready Reference Book

We have just issued a vest pocket, leather bound booklet on electric wires and cables which contains much invaluable information for Electrical Engineers, Contractors, Dealers, Wiremen, etc. The book is accurately indexed and contains in tabulated form such valuable data as: properties of aluminum; comparison of copper and aluminum; resistance of aluminum; diameter of each wire in stranded cables; number of wires in stranded cables; temperature coefficients; resistance of pure copper wire; weights, etc., of weatherproof wire and cable; rubber covered wires and cables; magnet wire; office wire; annunciation wire; electric heater cord; fixture cord; weights of copper, aluminum, iron, steel and brass wires; melting point, specific gravity and relative conductivity of metals; Matthiessens standard; carrying capacity of bare and insulated wires (amperes); relative resistance of metal alloys; tensile strength of copper wires; also complete information on insulated wires as recommended by the National Board of Fire Underwriters.

A copy of this handy booklet will be mailed to you FREE upon request.

Drop us a card today—right now, before you turn the page over—and receive your copy before the supply is exhausted.

THIS

TRADE CANADA WIRE & CABLE CO. LIMITED CANADA TORONTO CANADA MARK

REPRESENTS CANADIAN GUARANTEED QUALITY

Bare and Insulated Wires. Railway and Power Feeder Cables in Copper and Aluminum
Copper Trolley Wire
Copper Clad Wire
(Duplex Metals)
Galvanized Steel Strand Guy Wire

We can make immediate shipments from stocks carried at Toronto, Montreal, Winnipeg and Vancouver.

CANADA WIRE & CABLE CO. LIMITED CANADA TORONTO CANADA

Canada
Wire & Cable Co., Limited
1160-1170 Dundas Street
Toronto, - Ontario

Sales Offices:

401 Lake of the Woods Bldg.
Montreal, Que.

A. E. Esling, 150 Princess St.
Winnipeg, Man.

Macdonald, Marpole Co., Ltd., 427 Seymour St., Vancouver, B. C.

Swedish Electrical Machinery

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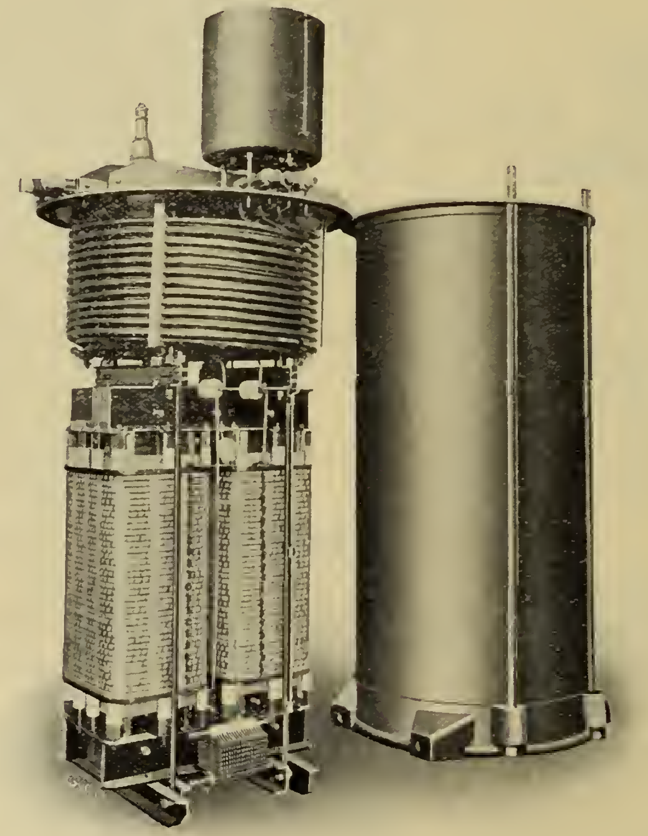
Efficiency and Workmanship



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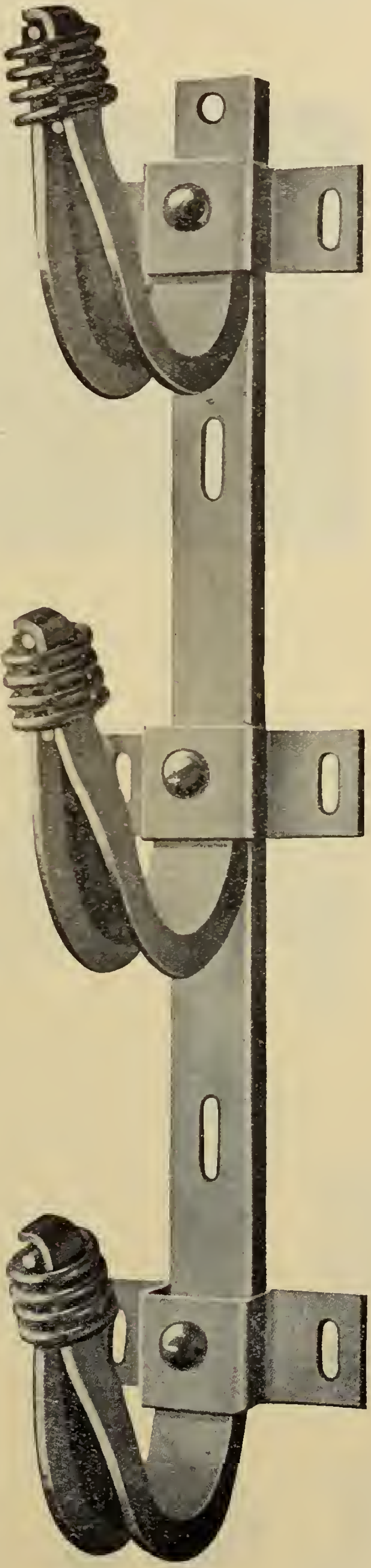

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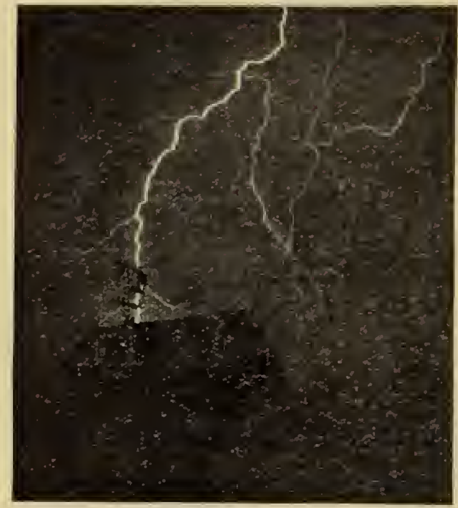

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Vol. 23 Toronto, March 1, 1914 No. 5

Special Rates for Cooking

It is open to question whether central stations in general are giving sufficient attention to the load that may be developed along the line of electrical cooking. The electric range, in common with many other household current consuming devices, is to be looked upon almost entirely as an off-peak load and as such means pure velvet to many companies and municipalities. The biggest commercial problem that confronts the seller of the electric current is the filling of the valleys in his load curve, and as a consistent day to day "filler" it is doubtful if there is anything to compete with the electric range—except it may be the electric heater which is not yet established on a commercial basis for the average consumer. This being the case we think the central stations should go after the cooking business vigorously, using plenty of their best bait—a low rate of current.

Campare the range, for example, with the electric iron, one of the most generally used pieces of household electric equipment. The iron sells much more readily, it is true, on account of its low price, but it must be remembered that the central station is not in business to make money by selling equipment but by selling current. The average consumption of a sad-iron is only, say, 500 watts and is used, say, two hours a day, one day in the week, consuming 1,000 watt hours per week or 4 kw.h. per month. The range, on the other hand, is used three times a day every day (and often between meals), with a total consumption for an average family of, say, 100 kw.h. per month. The range is thus a 25 times better customer. In addition, its load is distributed pretty evenly over the seven days of the week, while possibly 75 per cent. of the ironing is done the same day, Tuesday, and at approximately the same hour.

The superior quality of electrically cooked food is now universally recognized, but there are three outstanding requisites before the electric range can become general. These are: (1) a reliable range; (2) a range at moderate cost; (3) electric current at moderate cost. The development of a suitable range rests with the manufacturer, and, we believe, there are now a number on the market fulfilling the requirements to a very fair degree. A range at low cost also rests with the manufacturer; it will come with increased demand and, indeed, there are promises that it will come in anticipation of an increased demand—which, to us, looks the better way of doing business. The cost of electric current rests with the central station and, in view of its off-peak nature and the promise of lower price for ranges, we think managers will be well advised in shading their current charges very materially. In different places in Canada rates from 1c to 1½c have been given for some time and the reports are very favorable. The objection sometimes advanced to these low rates—that they discriminate against the poor man—has been proven absolutely fallacious. As a matter of fact, this extra revenue, which is abtained at practically no cost, is taken out of the pockets of the better-to-do customers to the financial advantage of the general consumer.

Electricity and Irrigation

In the daily discussion of the various uses to which electricity can be advantageously put on the farm the question of irrigation seems to have received much too scant consideration. We read the time-worn story of pumping the farmer's water, cutting his feed, milking his cows, or some other more or less impracticable suggestion such as threshing his grain and plowing his fields—these all to be done by electricity so as to make farm life easier and more attractive, but, be it noted, more expensive. Little has been said, however, about the use of electricity to increase the income of the farmer, and this, in all probability, is as interesting a question to him as it is to the average city toiler.

In sections of the country where irrigation has been practiced it has been shown that it is possible to turn lands from a barren, useless condition into fruitful, revenue-producing areas by the constant and judicious supply of water. In western Canada irrigation has met with considerable success and in the western United States the same is true. There are cases where lands valued at less than $20 an acre have by the expenditure of $30 an acre in the installation of a complete irrigation system been given values varying from $150 to $2,000. Intensive farming is not practised in Canada to such an extent as in some of the older countries, but in a modern system of irrigation there seems to be little doubt that the productiveness of the average farm could be increased from 25 to 50 per cent. in the average year and from 50 to 100 per cent. in our worst years. In a word, proper irrigation gives the farmer the control of the rain fall, which, at the present time, is the most irregular and unreliable factor in the production of his crops. It would appear then that the Hydro-electric Power Commission would be well advised in adding this equipment to the list they already advocate for the farmer.

Another point it is well to emphasize is that power used for irrigation may be so applied as to add nothing to the total power bill of the farmer for the year. For example, the irrigation of 100 acres may require, say, a five or ten horse-power motor, but this power need not be used at such time as the power is being used for other purposes, which would also leave all the power available for use around the building during the long winter months when it is all needed there. That is, the load the farmer has around his buildings can be worked in with the irrigation pumping system in such a way that the power contracted for to take care of either can just as well be used for the other system. On another page in this issue we give a brief sketch of one of the most extensive electrically-operated irrigation systems in the world, but in the near future we hope to discuss this matter at greater length and give figures which will indicate more in detail what is being done in this most important industry. After a somewhat detailed study of the conditions the Electrical News is convinced that a much greater benefit will accrue to the farmer at a comparatively small cost than is at present understood by the average tiller of the soil.

Canadian Members of International Congress

In connection with the International Electrical Congress to be held September 15 to 18, 1915, at San Francisco, Cal., U. S. A., during the Panama-Pacific Exposition, the following Canadians have been appointed honorary members of the international committee on Congress organization,—Dr. L. A. Herdt, Mr. Ormond Higman, Mr. A. B. Lambe, Prof. L. W. Gill.

The proceedings of the International Electrical Congress will be divided into twelve sections, relating to the principal branches of electrical engineering, and it is expected that about 250 papers will be presented covering a wide range of topics. The San Francisco Congress of 1915 will be held under the auspices of the American Institute of Electrical Engineers and is authorized by the International Electrotechnical Commission and the Turin Electrical Congress of 1911. The International Electrotechnical Commission will meet at San Francisco during the week preceding the electrical congress.

Great Waterways Union

At a meeting of the executive of the Great Waterways Union, held recently in Berlin, Ont., it was decided to take a large delegation to Ottawa to urge the following measures: —(1) To ask for an ocean waterway of 35 feet from Montreal westward to the head of the lakes, and that the international features of the project be taken up with the United States for the earliest possible determination. (2) To ask the assistance of the Dominion Government in finding means to greatly increase the amount of power in the Niagara Peninsula for the use of the Hydro-electric Power Commission, it being understood that the improvement of the St. Lawrence will of itself supply Eastern Ontario with millions of horse-power, greatly to the benefit of the manufacturers, cities, towns and the farming communities, with the view that Hydro-electric power may become universally used in the Province of Ontario, and for the full benefit of the people, urban and suburban. (3) That the usual Dominion subsidy of $6,400 per mile be given to important projected Hydro-electric railway lines. Private companies have invariably received such aid, and the people's own lines should receive as liberal treatment with the view of encouraging intensive farming, cheaper living, better transportation. Such accommodation wherever supplied has doubled and trebled the value of land.

Severe Test for Generators

Recently in the presence of a number of representatives of central stations, the engineers of a large manufacturing concern deliberately short-circuited a 16,700 kv.a. 8,800 volt generator, running at full speed and without resistance or any other protection in the circuit. Oscillogram records showed that a current of 21,000 amperes, being 12½ times normal, flowed through the generator.

With generators as designed some years ago such a test would have wrecked the machine, but in the present instance no damage whatsoever was done. The only visible effect was a static flash between the field and the armature. The test was performed to prove the fact that generators are being built that require no outside protection from outside short circuits, the generator itself being so designed as to be self-protecting. Unless the generator is properly constructed a complete short circuit tears out the armature coils, which, coming into contact with the revolving field, causes extensive wreckage. Furthermore, the static flash, which always occurs under such circumstances, will destroy inferior insulation. With generators of the type tested, however, both results are guarded against by firmly securing the armature coils and bracing their ends, and by the use of mica insulation. In consequence even so severe an ordeal as this test was withstood without harm, although, we understand, it has been repeated many times with the same machine. In connection with this test several others were carried out in order to prove the reliability of circuit-breakers and reactance coils for protecting the feeder circuits. The generator was repeatedly short-circuited through these devices which stood up admirably under the enormous stresses to which they were subjected.

The practice recommended by the company is to protect the feeders and not the generators. If the generators are protected and a short circuit occurs on any of the feeders, even a poorly designed generator will not suffer; the voltage will fail on all the feeders, all synchronous motors will be thrown out of step, and an overwhelming overload will be thrown on the circuit-breaker of the short-circuited feeder, since it will carry the total curent of all the generators in the station. If, however, protective reactances are placed in each feeder circuit, and a short circuit in a feed occurs, only that feeder will be affected and even then its reactance coil will prevent the current in it from rising to too high a value. The voltage will be maintained at the bus bars and no disturbances will be felt in the remaining feeders; this is, of course, provided that the generators are self-protective; if not, such an event may seriously injure them. It is, of course, possible to protect non-self-protecting generators by reactances, but as the test described above shows, such a proceeding is unnecessary since generators can be supplied that are immune to the worst conditions of load that can be imposed upon them.

Design of d.c. Machines

Professor A. M. Gray, assistant professor of electrical engineering, McGill University, addressed the members of the Montreal Electrical Society on the subject of "The Design of d.c. Machines," at a meeting held in the lecture room of the Engineering Building, McGill University. Professor Gray opened his lecture with the statement that, although a knowledge of the characteristics and operations of direct current machinery is not of as much importance to operating engineers in this country as is a knowledge of alternating current apparatus, yet the field of the d.c. machine is extending, as for instance for long distance transmission by the Thury system, and also for trunk line electrification at 2400 volts.

The characteristics of standard d.c. generators and motors were then discussed, and, in particular, the subject of commutation was taken up experimentally, and the methods of improving commutation by shifting the brushes and by the use of carbon brushes were explained. It was pointed out that the secret of the carbon brush lay in its high contact resistance, and that this generally prevented its application to old machines built with copper brushes. When copper brushes were used the energy lost at the low resistance contacts was slight, and a small commutator was used. If, however, carbon brushes were used on the same machine, the energy lost at the high resistance contacts would cause excessive commutator heating.

The use of interpoles was taken up in the discussion.

In a motor without interpoles the brushes are shifted backwards, so that the coils being commutated are under the pole tips and in a suitable magnetic field; by the use of interpoles the suitable magnetic field is brought up to the coils. Such machines have the advantage that the commutating field increases with the load, and is independent of armature reaction. They will therefore commutate well even when greatly overloaded or when operating with a weak main field such as one finds in adjustable speed machine tool motors, where a speed range of 3 to 1 is required by field weakening.

High speed motors are more difficult to design than those for lower speeds, because the conductors cut lines of force faster, and the voltage between segments is generally greater. That this is admitted by designers may be seen by the fact that high speed motors are generally supplied with interpoles.

The cost of motors for different purposes was touched on incidentally, and, in that connection, the following table is of interest. A motor of a given size could have the following ratings, suitable windings being supplied in each case:

Open type		Enclosed type		Crane & Hoist type		Adjustable speed	
h.p.	r.p.m.	h.p.	r.p.m.	h.p.	r.p.m.	h.p.	
15	375	10	375	35	375*	20	375/1200
20	500	14	500	45	500*	27	500/1200
30	750	21	750	25	375 †	40	750/1200
40	1000	28	1000	35	500†		
40° C. rise		50° C. rise		40° C. rise open		40° C. rise	
				50° C. rise enclosed		after 3 hrs.	

* One half hour rating. † One hour rating.

Brantford Will Buy Electric Road

For the past two years the city of Brantford has been involved in litigation with the Grand Valley Railway Company regarding the operation of the Brantford Street Railway System and its allied lines. On account of the wide interest shown in this matter a brief history of the complete situation will be opportune.

In 1902 the city of Brantford granted a franchise to the Brantford Street Railway Company, to run for 50 years, to operate a street railway system in that city. In 1907 this franchise was transferred to the Grand Valley Railway Company, which in the mean time had acquired the assets and property of the Brantford Street Railway Company. The franchise as granted to the Grand Valley Railway Company was amended somewhat and required the building of extensions on a large number of the city streets, amounting in all to some nine or ten miles, with the reconstruction of the entire system as it existed in 1907. The city claimed that the Grand Valley Railway Company had not observed the terms of their agreement, and therefore forfeited their franchise. Action was accordingly brought in 1912 and judgment for forfeiture was given in 1913. The company appealed later in 1913 but their appeals were dismissed. They were however allowed a reasonable time in which to fulfil certain terms of the original agreement. On February 6, 1914, the company applied for extension of time to fulfil these optional conditions imposed by the last judgment or, failing that, to endeavor to find a purchaser for the road.

The city of Brantford at this point decided it would be better to put in a bid for the property at once. This they did and along with another bid from Mr. W. P. Kellatt the tenders were considered during the second week in February and the property allotted to the city of Brantford at a price which is understood to be approximately $250,000. The property included in this contract is the total rolling stock and lines within the city and the lines between Brantford and Galt, a total in all of about 40 miles. A by-law will be submitted to the Brantford ratepayers at an early date authorizing the execution of this contract.

The above sum includes a first mortgage of $125,000 which would have to be taken care of first. Of the remainder, after paying city taxes and bond interest in arrears, there remains about $96,000, which would be all there is left to take care of $59,000 first mortgage bonds and $1,-700,000 second mortgage bonds of the Grand Valley Railway. It has yet to be decided by the courts whether this first mortgage ranges prior to the second.

Irrigation Electrically Operated

The largest motor-driven irrigation pumping plant in the world has just been completed for the Crane Falls Power & Irrigation Company, Idaho, by the Canadian consulting engineering firm of Smith, Kerry & Chace.

This district is known as the Glen irrigation district and comprises an area of 30,000 acres, in the valley of the Snake River, having an altitude of approximately 2,300 feet above sea level. Since May, 1913, this area has been rendered fruitful by the use of water taken from the Snake River, lifted by means of electrical pumps into canals on an elevated plateau by means of two pumping stations which include nine motor-driven pumps arranged in four batteries.

Three pumps lift the water to an elevation of 175 feet, two to an elevation of 100 feet, two to an elevation of 60 feet. In another smaller station two more pumps raise the water 104 feet.

The entire output of the nine pumps is approximately 200,000,000 gallons per 24 hours, which, allowing 75 gallons per head, would supply almost 3,000,000 people. To operate the system at full capacity requires approximately 6,000 h.p of motors.

The reasonableness of such a proposition has been demonstrated by the fact that the total expense of this installation, which results in the production of 30,000 acres of wonderfully fertile land, has been made at a cost calculated at something less than $28 per acre. A brief description follows, which, in view of the considerable efforts being made in Canada in the same direction, will be of considerable interest to the engineer.

The system consists of four main canals supplied through wood stave pipes varying in size from 4 ft. 6 in. in diameter to 3 ft. in diameter. In all there are 9,662 lineal feet of pipe, some of which operates under a pressure as high as 75 pounds. The four canals are known as A, B, C, and D. Canal A supplies a territory of 11,760 acres and has 1,225 stations 100 feet apart; canal B covers 7,916 acres and has 693 stations 100 feet apart; canal C covers 6,244 acres and has 596 stations 100 feet apart; canal D supplies an area of 2,805 acres and has 176 stations 100 feet apart.

Station No. 1, the largest of the two pumping plants, as stated above, contains seven pumping units which feed the A, B and C canals. The A pumps, of which there are three 18-in. sets, each discharge 38 cu. ft. per second against a 177 foot head and are driven by 1,100 h.p. motors. Canal B is supplied by two 20-in. sets, each delivering 43 cu. ft. per second against 108 ft. and driven by a 750 h.p. motor. Canal C is also supplied by two 20-in. units discharging 30 cu. ft. per second against a 70 ft. head and driven by a 350 h.p. motor. In station No. 2 the equipment consists of two 14-in. units each, discharging 16 cu. ft. per second against 110 ft. head into canal D.

The power for the operation of the motors is taken from a 40,000 volt line of the Idaho Railway, Light & Power Company, and transformed in the two stations down to operating voltage.

Telegraph Statistics for 1913

A copy of telegraph statistics of the Dominion of Canada for the year ending June 30, 1913, issued by the Department of Railways & Canals is just to hand. The report shows that 9 land telegraph companies are now operating in Canada as follows:—Anglo-American Telegraph Company, Canadian Northern Telegraph Company, Canadian Pacific Railway Company's Telegraph, Dominion Government Telegraph Service, Grand Trunk Pacific Telegraph Company, Great North Western Telegraph Company of Canada, North American Telegraph Company, Temiskaming and Northern Ontario Railway Commission, Western Union Telegraph Company. In addition the following cable companies made reports: Anglo-American Telegraph Company, American Telegraph and Cable Company, Commercial Cable Company, Direct United States Cable Company, Halifax and Bermudas Cable Company, Pacific Cable Board. In addition to this the Marconi Wireless Telegraph Company, which is in a class by itself in that it operates on neither land nor water, submitted a report.

Province.	Pole Mileage.		Wire Mileage.	
	1912.	1913.	1912.	1913.
Nova Scotia	2,828	2,907·25	9,878	9,412·49
New Brunswick	1,867	2,251·25	8,376	7,297·34
Quebec	7,515	7,035·25	24,249	25,242·20
Ontario	10,514	11,166·90	58,207	47,682·55
Manitoba	3,803	3,808·00	18,184	13,697·10
Saskatchewan	5,382	5,863·65	21,257	19,499·80
Alberta	2,895	3,476·05	14,491	16,193·05
British Columbia	3,467	5,838·14	10,571	13,192·46
Yukon	2,498	688·00	2,713	688·00
Newfoundland	14	14·00	14	14·00
	40,785	43,048 49	167,939	152,918 99

The report includes interesting figures with regard to the capitalization, gross and operating expenses, salaries, etc.; also with regard to the mileage of the land operating companies. The facts with regard to pole and wire mileage in 1912 and 1913 are shown in the accompanying table. The total wire mileage is 152,919 miles.

Telephone Statistics for 1913

Telephone Statistics for the Dominion of Canada for the year ending June 30, 1913, have just been published by the Department of Railways & Canals and show a marked increase in the use of telephones within the last twelve months. The report states that as far as these figures are complete there is one telephone now in use in Canada for every 16.2 persons and it is thought that if absolutely complete figures had been received this number would be lowered to possibly 15. The total number of organizations which made statistical returns to the department was 1,075. The report states that there are over 100 organizations known to the government from which replies were not received and that there are probably a considerable number of smaller organizations of which the government has no direct knowledge. It is evident, therefore, that the total number of telephone companies at present operating in Canada would be 1,200 or possibly 1,300 altogether.

The character of the various telephone organizations varies considerably in the different provinces. In Alberta the telephones are operated by the provincial government as one comprehensive system. In Manitoba this is practically the case, but there are a number of telephone companies still operating. Saskatchewan, while having its government system, has also a very large number of small stock companies. In Ontario and Quebec the situation is pretty well controlled by the Bell Telephone Company, especially in Quebec. In Ontario the number of stock companies and co-operative companies has increased rapidly so that Ontario's total of telephone organizations is greater than in any other province of the Dominion. In British Columbia the situation is pretty well controlled by one large company as is also the case in the Maritime provinces. The table herewith explains the distribution in the various provinces very fully.

Province.	Government.	Municipal.	Stock.	Co-operative.	Partnership.	Private	Total.
Nova Scotia			21	28	17	17	83
New Brunswick			12	3	1	9	25
P.E. Island			1				1
Quebec			44	26	3	28	101
Ontario	1	38	143	148	41	80	451
Manitoba	1	7	5	14	1	7	35
Saskatchewan	1	5	304	42		9	361
Alberta	1	1	1				3
British Columbia		1	12	1		1	15
Total	4	52	543	262	63	151	1,075

The report shows that there are now 1,092,587 miles of wire in use with 463,671 telephones. The gross earnings in 1913 were $32.13 per telephone, and operating expenses $24.10 per telephone. Capitalization works out to $129.13 per telephone. Of the total number of telephones in use 269,843 are central energy type and 193,828 are magneto type. The report contains the names of, and a quantity of interesting information regarding every telephone organization in Canada.

Shawinigan Presents Good Report

During 1913 the gross earnings of the Shawinigan Water and Power Company were $1,690,882, an increase of $121,211, while the net earnings of $1,473,439 were $99,719 higher. Operations and maintenance and general expenses amounted to $217,442. The interest on first mortgage bonds, debenture stock, together with general interest, aggregated $501,360, leaving a net revenue of $972,079, which with the balance brought forward from 1912 of $24,281, left available for distribution the sum of $996,361. A dividend of six per cent. was declared.

Mr. J. E. Aldred, president of the company, in the course of his report at the annual meeting, stated: "With the completion of the addition to the company's two plants at Shawinigan Falls, now under construction, we shall have made the largest single increase in capacity ever undertaken by your company. This installation consists of three additional units of a total capacity of 45,000 h.p. The transmission system of your company has also been materially strengthened by the building of a second transmission line of the steel tower type to the city of Three Rivers, which city continues to develop as a market for power. The amount of power now being transmitted over the company's transmission system to Three Rivers and the Asbestos district approximates 20,000 h.p., which is about fifty per cent. of the amount being transmitted over the company's system to Montreal and vicinity (45,000 h.p.)."

Mr. Aldred also reported satisfactory progress with the Cedars Rapids development, which, he said, was being carried out in a most creditable manner under the direction of the chief engineers of the Shawinigan and Montreal Light, Heat & Power Companies. He added: "It is confidently expected that to the extent of one hundred thousand horsepower this plant will be completed within the time originally estimated, January 1, 1915, and further, that with the development complete and machinery installed to this capacity, the cost will be kept well within the estimated amount provided for this purpose. The putting into operation of the Cedars Rapids plant will still further strengthen the position of your company and its allied companies, in their field of operation. While the supply of power to Montreal will be augmented by the utilization of the Cedars plant, this will allow your company greater latitude in the sale of its power at points within easier reach of the power plant at Shawinigan Falls."

The company have interests in ten subsidiary concerns, four of which, the North Shore Power Company, the Laval Electric Company, the Continental Heat & Light Company, and the St. Maurice Light & Power Company, were, said Mr. Aldred, auxiliaries of Shawinigan, distributing power from the main generating plant in various districts covered by the company's operations.

The retiring board of directors was re-elected as follows: J. E. Aldred, president; Thomas McDougall, chairman; R. M. Aitken, H. S. Holt, John Joyce, Sir William Mackenzie, Sir M. Mitchell-Thomson, Bart., Denis Murphy, Howard Murray, Julian C. Smith, W. R. Warren, E. R. Wood. Several changes were made in the executive, Mr. T. McDougall, the former vice-president, being elected to the new office of chairman of the board of directors. Mr. Howard Murray, formerly treasurer, and Mr. Julian C. Smith, formerly chief engineer and general superintendent, were elected vice-presidents and will have charge of the business and the operating departments respectively. Mr. W. S. Hart, formerly secretary, was appointed treasurer, and Mr. Jas. Wilson, formerly accountant, becomes secretary.

Winnipeg Electric Annual

Sir William Mackenzie in presenting the annual report of the Winnipeg Electric Railway Company for the year ending December 31, 1913, which indicated that gross receipts and net earnings were respectively 8.32 and 3.68 per cent. in excess of the corresponding figures for 1912, reviewed the development work of his company for the past year. The extensions included the following:

18.147 miles of track have been laid as follows: 8.06 miles with 80-lb. rails with concrete foundation and asphalt pavement; 9.341 miles of surface track with gravel ballast; which includes a new line to the Manitoba Government's new Agricultural College, in the municipality of St. Vital.

Forty large double truck closed motor cars, 45 feet long, with wide vestibules equipped with air brakes and all other modern appliances to ensure the comfort and safety of passengers and trainmen, were constructed in the company's Winnipeg shops and put in service.

In extension of the company's electric lighting and power distribution system, there were erected 2,123 additional poles and 395,070 lbs. of wire, in addition to which the company has put down 386,312 duct feet of underground ducts and installed therein 114,440 feet of underground cable leading from the company's Mill street sub-station along Portage Avenue in the central part of the city to take the place of a large amount of overhead wire.

A brick and reinforced concrete with concrete foundation sub-station erected at Transcona, two storeys, with concrete roof, together with boiler room and heating apparatus. Installed in this building are 6,000 kw.'s in transformers, and switching apparatus with available floor space for two motor generator sets.

A brick and reinforced concrete addition to the Mill street sub-station, 40 by 60 feet, two storeys, with concrete roof and concrete foundation, and installed in this building 6,000 kw.'s in transformers and switching apparatus.

A four-storey reinforced concrete fireproof building erected on Assiniboine Avenue, to be used for the storage of gas stoves and gas appliances, and as an electric and gas meter repair and testing shop, with space provided for the use of the Dominion Government in testing meters. The ground floor is used as a garage for the storing of the company's electric and gasoline tower and service wagons and trucks. A charging set has been installed there for charging electric automobiles and cartage trucks for the public.

Adjoining the company's Mill street sub-station the company have constructed a brick storage battery house, 41 by 194 feet, in which has been installed a 6,000 ampere hour storage battery, for storing electric current when the demand is light to be used during the time the demand is heavy, and also as a protection against any interruption that may occur at the generating plants or the transmission line. This plant, when charged, is capable of taking care of the company's railway system in the central part of the city for a considerable time without assistance from the generating plants.

A reinforced concrete sub-station constructed at the Canada Cement Works, South Winnipeg, and installed 4,200 kw. transformers with the necessary switching apparatus

A 22,000 volt transmission line constructed from the Canada Cement Company's plant to the new Agricultural College in the municipality of Fort George, a distance of 6.1 miles from the cement works, and 1,500 kw. transformers installed at the new college.

The company's new ten-storey fireproof office building, which was commenced in June, 1912, is now completed and occupied, and is the most modern and up-to-date fireproof office building in Canada; the company occupying the basement and the first two floors.

Among the large contracts closed by the company during the year 1913 are the following: with the Manitoba Government for lighting and electric power at the new Agricultural College Farm and College Buildings; with the Canada Cement Company for electric power for their new manufacturing plant at West Winnipeg, which has a capacity of 4,000 barrels of cement per day; with the Canadian Pacific Railway Company for electric lighting and electric power for their new shops and roundhouses at North Transcona.

During the year 1913 your directors have been granted franchises and have made contracts for new railway lines in the municipalities of St. Vital and Fort Garry, which are adjacent to Winnipeg, and for electric lighting and electric power privileges in the municipality of St. Vital, and in addition, have made contracts for street lighting in the municipalities of Assiniboia and St. Vital.

It has since been announced that the J. G. White Engineering Corporation of New York have been engaged to make surveys and design plans for the new hydro-electric development on the Winnipeg River.

Important Resolutions

At the fifth annual meeting of the Commission of Conservation a number of important resolutions were passed dealing with the preservation of our natural resources. One of the most important dealt with waters and water powers and read as follows:—

Resolved that all possible information respecting the waters in Canada, connected directly or indirectly with boundary waters, should be collected and digested.

Resolved that as accurate data respecting the flow of streams is absolutely necessary in developing water-powers, all existing information respecting gauge readings, measurements of stream flow and other cognate data in the possession of the Dominion Government, the Provincial Government, corporations and individuals should be collated and published.

Power Distribution for Manitoba

Extracts from a comprehensive report just submitted to the Manitoba legislature on the generation and distribution of hydro-electric power

By Commissioner Robson

Commissioner Robson has just submitted his report to the Manitoba Government on the practicability of power development and distribution, from Winnipeg River, for the general use of the province of Manitoba along lines somewhat similar, it is presumed, to the scheme of the Hydro-electric Power Commission of Ontario. This report was made in compliance with a resolution passed at the last session of the Manitoba Legislature. In compiling his figures, Mr. Robson has based them on the summary of water powers of Manitoba, recently made by the Water Power branch of the Department of the Interior, Ottawa, and on figures relating especially to transmission line costs submitted by Mr. W. E. Skinner, acting for the Board of Commissioners. The cost of development in transmission as determined by Mr. Robson can scarcely be considered favorable or likely to arouse any particular enthusiasm for the immediate prosecution of the general scheme of distribution. It is probable the Commissioner has taken a somewhat unfavorable view of the situation, especially as such a scheme would invariably be followed by a very unusual industrial development which would greatly increase the demand for power and thus reduce the cost figures. This has been the experience of the Ontario scheme, where the demand for power has very much exceeded expectations. The figures given in the report are nevertheless exceedingly interesting, and we reproduce sections of it herewith.

"Of outstanding importance is the report of the water powers branch of the Department of the Interior, which was prepared by the officials of the water powers branch for the purposes of this inquiry. It has already been transmitted to you. Any careful reader of that report will at once be struck with its fullness and detail. It is difficult to appreciate the magnitude of the labor of its preparation. Its cost was wholly borne by the Department of the Interior, and I am told it has involved altogether an outlay of about $60,000. The undertaking of such an investigation and report independently of that department would have been impossible in the time that has elapsed, and it is likely that the expense alone would have been prohibitive of any such exhaustive study by this province, at this juncture.

"It is to be observed that the resolution contemplates electric service throughout the province. The expression is 'for all sections of the province, rural as well as urban.' The reports herewith, and this memorandum, have been prepared with this generality of the projected system in mind. Certain parts of the province, even occupied parts, cannot be reached by such a system. But in view of the breadth of the resolution, the study was undertaken with a view to covering the province wherever that would be at all practicable. Such a study is, in short, an experiment by assuming a hydro-electric system of certain capacity with transmission lines and distribution apparatus and equipment, and then estimating the market within reach of the lines, thereby ascertaining roughly what the cost of power would be delivered within reach of the consumer.

"The general subheads under which an inquiry of this nature distributes itself include (1) the available source of power, that is, the possible river development; (2) the cost of river development; (3) the transmission to distributing centres; (4) distribution; (5) the demand; (6) fixed charges, probable operating costs and the revenues; (7) general observations.

Available Source of Power

"There is already a general acquaintance with the facts as to the existing water powers of Manitoba. Those on the Winnipeg river are notably feasible and capable of immediate development. The well-known city of Winnipeg and Winnipeg Electric Railway hydro-electric plants form existing developments on that river.

"The total possible power development of the Winnipeg river in Manitoba (according to the Water Powers Branch reports) on a basis of 20,000 second feet regulated flow, including the ultimate supply of the city of Winnipeg plant, placed at 76,800 horse power, and the present development of the Winnipeg Electric Railway Company's plant at 26,500 horse power, is 409,700 horse power at a 75 per cent. efficiency basis, as shown in the water powers branch report.

"The total power required to supply the city of Winnipeg at an approximate population of 250,000 is in the neighborhood of 47,300 horse power, or 35,285 kilowatts. Taking these figures as a basis for ultimate requirements, the total possible power development of the Winnipeg river would be reached when a population of approximately 2,165,500 had been served.

Winnipeg River

"These figures demonstrate that the relation of the Winnipeg river to Winnipeg will be of increasing importance, and that consumption equal to its whole development may result in Winnipeg alone. With an electric service for now occupied parts of the province also in mind, it is obvious that general demand in Manitoba will ultimately require the whole of the force to be found on that river.

"The water powers branch has gathered voluminous data regarding the northern rivers, but it is out of the question at present to expend large sums in the engineering work necessary for the estimating of costs of actual adaptation of the falls there for power purposes. That they will eventually exert an immense influence on northern development cannot be doubted, but owing to the distance from population they are not likely to be harnessed up immediately. As will be remarked hereafter, it would seem that the northerly area of the now settled portion of this province cannot, in the present stage of the art, be reached with power from the Winnipeg river. Were a source of power for that area sought, it would be found in the Grand Rapids, where the Saskatchewan river flows into Lake Winnipeg. At this writing there has not been time, even if the cost were authorized, to undertake the work of estimating the cost of development at those rapids, but it can be said with general knowledge of the cost of development transmission and distribution, that there is as yet no market to justify the installation of a hydro-electric service for that area from that power source. In present conditions, therefore, is does not appear to the undersigned to be expedient to advance further with this inquiry as to the river powers in the far north or at Grand Rapids. The possibilities of economical use of the Winnipeg river, situated as it is nearer population, bring the proposal close to feasibility, and this report, therefore, becomes narrowed down to considerations involving the Winnipeg river.

"As above stated, there are seven water powers on the

Winnipeg river in Manitoba, described in the report already mentioned. Three of these are left out of present consideration. They are, the two already developed, i.e., the city of Winnipeg's power at Point du Bois[1], the Winnipeg Electric Railway Company's[2] plant at Pinawa Channel, and the Big Bonnet[3] falls, now said to be in the hands of the Winnipeg Power Company, and intended for immediate use. Of the remaining powers, certain may be subject to outstanding rights, but are in the dormant class. What is said here is subject to those rights.

Distribution

"While the location of possible hydraulic plants is practically determined by the presence of the rapids, the courses of transmission and distribution lines are just now merely suggestive. All that can be done is to project lines through what would be, as well as can now be defined, the area of demand. Subject to similar remark is the estimate of cost. Actual surveys could not be made merely for this preliminary view of the question. Construction difficulties now unforeseen might well arise and increase cost. The extent of much of the necessary expenditure cannot now be made much more definite than estimate, justified as well as possible by experience in other ventures. All work of this nature, labor, machinery and material, is subject to frequent change owing to state of demand and market and variance of device. It is necessary that an attempt be made in the way of projection of line and sub-stations in order to base some idea of the cost of such a public service system as is in mind, and the best has been done in that direction that the limited time and data will permit. It is subject to these conditions and uncertainties that the estimates contained in Mr. Skinner's report now submitted have been prepared. To illustrate the report certain maps showing projected transmission and distribution lines accompany it. While the source of the river power is shown on the map as Pine Falls[4], the cost will be relatively the same in respect of any available location, as there is no great difference in distance.

"The course of the projected transmission line, which was in contemplation by Mr. Skinner in framing his report, is from Pine Falls to Winnipeg, thence making a loop through Portage la Prairie, Brandon, to a point near Minto, thence through Roland and Morris to Winnipeg. This line would, it is supposed, be at 110,000 volts. From Brandon to Hartney, and also from Brandon to Wawanesa, would be transmission lines at 60,000 volts. Branching from high tension sub-stations at these points named are 15 transmission lines of 30,000 volts, covering altogether 525 miles, for the purpose of reaching the various sub-stations through which the consumer is to be supplied.

"At the various community centres, which the 60,000 volt and the 30,000 volt lines would touch, would be located additional sub-stations to convert the voltage at either 6600 or 2200 volts for delivery to the towns, villages and rural districts.

"The total estimates in river work, transmission lines and sub-stations, as estimated in the water powers branch report and Mr. Skinner's report, is $9,902,109.

"After the power has been delivered to the various towns and villages along the route, the problem of local distribution must be considered.

"In such public undertakings the usual method is for transmission of power in bulk, as it may be termed, to municipalities, who themselves take charge of the local distribution. The projected transmission lines were drawn with the idea of reaching population within reasonable limits. For this purpose, to serve all who would be within reach of the scheme would require, it is thought, forty sub-stations. The estimate of $9,902,109 ends with the work at these sub-stations. To carry the power from the sub-stations to the consumer would, it is estimated, cost the municipalities $1,455.30 per mile of line.

"In addition to the cost of rural distribution, however, it must be remembered that each farmer must supply, in addition, his own transformers, house wiring, motors, etc. This cost will vary from $200 to $1,500, depending on each consumer's requirements. The total number of rural consumers, as estimated, is 6,000. In the four districts shown it was found that the average possible consumers per station was 220, based on the number now using telephones within a radius of seven miles of the centre of distribution. As a total of forty sub-stations is proposed, it may be assumed that there will be an average of 150 consumers per station, or a total of 6,000 consumers. Allowing one mile of construction at $1,455.30 per mile for each consumer, the total cost of 6,000 miles of distribution lines would be $8,731,800

"It has been estimated that in 37 towns and villages within range of the projected transmission line there is at present installed approximately 11,000 horse power capacity in steam and gasoline engines and motors. Much of the above power is at present installed to operate mills, elevators and electric light plants. Elevators are only operated during a portion of each year, and the same is also practically true of mills, while electric light plants generally operate throughout the year. The load factor, or ratio of the daily output in kilowatt hours to the maximum possible output, is therefore relatively low.

"The question of the immediate feasibility of the general provincial undertaking depends upon the financial result. The following compilations have been made, and, it is thought, are conservative. They are submitted subject to the qualifications already expressed as to estimates of cost of construction which likewise apply in some degree to cost of operation. The demand is probably given at a figure that would soon be exceeded.

	Investment	Depreciation
Generating station	$3,177,400	$ 63,548
110,000 volt lines	2,545,123	76,354
60,000 volt lines	310,906	9,327
30,000 volt lines	2,575,125	77,254
Winnipeg sub-station, 110,000 volts..	134,946	5,398
Brandon sub-station, 110,000 volts—	239,520	9,581
Portage sub-station, 110,000 volts....	120,832	4,833
Roland sub-station, 110,000 volts...	105,213	4,209
Hartney sub-station, 60,000 volts....	64,948	2,598
Wawanesa sub-station, 60,000 volts..	58,766	2,351
34 sub-stations at $16,745	569,330	28,466
Total	$9,902,109	$283,919
6,000 rural lines at $1,455.30	8,731,800	436,590
Total investment	$18,633,909	
Total depreciation		$720,509
Interest on total investment at 5%		$931,695

"The cost of operating a system as outlined has been based largely on unit costs derived from the city of Winnipeg electrical department report.

Operation of generating stations	$16,000
Maintenance and patrolling—	
952.75 miles of line at $60 per mile	57,165
6,000 miles of rural line	60,000
Operating six high tension sub-stations	48,000
Operating 34 sub-stations	40,800
General office expense	17,500
Commercial expense	20,000
Miscellaneous	15,000
	$274,465

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[1] 76,800 h.p. capacity; 20,800 h.p. developed.

[2] 66,500 h.p. capacity; 26,500 h.p. developed.

[3] 95,500 h.p. capacity.

[4] 63,100 h.p. capacity.

Cost per kw.h.

"The total annual cost per kilowatt hour on the distribution lines, and without taking into consideration cost of consumers' installation and connection with the system, is brought out at the following figures:

Depreciation	$720,509
Interest	931,695
Operation	274,465
Total	$1,926,669

"The estimated consumption, as above noted, is 8,308,320 kilowatt hours, and on the basis of, say, 10,000,000 kilowatt hours' output, the unit cost per kilowatt hour would be about 19.27 cents.

"The total annual cost to towns and villages only will be approximately as follows:

Depreciation	$283,919
Interest	495,105
Operation	177,580
Total	$956,604

"At an annual output of 5,908,320 kilowatt hours the unit cost to towns and villages only will be about 16.2 cents per kilowatt hour, which is undoubtedly greatly in excess of the present price for which they are generating their own power individually.

"The above figures in neither case provide for the cost of local distribution in towns and villages.

"Until such time as the development of the province will warrant building long transmission lines, it seems that the cheapest power for farmers obtainable must come from small gasoline installation, unless it is desired to promote the industrial development of the province by carrying a heavy deficit for a considerable period of years, It is clear that a general hydro-electric undertaking for the provision of electric service merely for the use of the agriculturist could not be accomplished on any satisfactory financial basis, and that such a scheme would depend on the growth of towns and villages, which would make such a demand for power as to give a foundation for the enterprise.

"The resolution of the legislative assembly points to the beneficial results in Winnipeg of the establishment of a publicly-owned and operated hydro-electric system. Conspicuous is the impetus to manufacturing in that city. The resolution seemed to have proceeded from the hope that all other sections, rural and urban, might be benefited by a like measure. There cannot be forgotten that there are many towns that, once supplied with cheap electrical service, would experience a stimulus similar in kind, though perhaps less in degree to that so well evidenced in the case of Winnipeg. It is not too sanguine an expectation that the electrical impulse throughout the province would increase local manufacturing and thereby augment population, and not only so, but the demand for power so arising would provide a market implementing the rural demand in such an extent that such revenues would be produced that the financial side of the undertaking would, as growth proceeded, become less formidable.

"There has become current a suggestion of a possibility of transmission into other portions of the province of surplus power to be purchased from the hydro-electric system of the city of Winnipeg. There is evidently a possibility of a greatly increased power development at Winnipeg's hydro-electric site. The city's demands are growing and its present development may soon be fully taxed. The city, however, is about to increase capacity, and will still have a possibility of further development to a very high figure. It should be within reason to expect that measures could be had to utilize that plant to capacity before expending large sums in new development. Such a course would be economical to all interests. There has been no expression of anyone in authority as to possible arrangements to this end, and at present it is nothing more than a suggestion. Without authority to approach the city authorities it is impossible to say on what terms such an arrangement might be made, if at all. To suggest, in this report, arrangements for extension of that plant so as to guarantee a constant supply for a provincial system, would be carrying the matter beyond the present reference. At the same time, I do not think this idea can be wholly dismissed from view.

"Full opportunity was given to the public to make representations upon the subject of this inquiry. It may be repeated what was said in the recent annual report of this commission:

" 'In June the commissioner invited, through the press of the province and by correspondence, the submission of evidence or representations, and intimated a desire to attend at any particular points for hearings on the subject. This elicited very few responses.

" 'Again, in October last, an advertisement was inserted in seventy-six newspapers throughout the province, inviting representations and suggestions upon all phases of the subject, and offering to attend at any community centre to hear persons interested, besides requesting correspondence. The commission's inspector visited all the important points in the province, collecting data touching the number of probable users of light and power in towns and vicinity, present method of supply population, and other facts and information necessary to form a comprehension of the aim and scope of such a far-reaching undertaking.'

"Expressions of opinion of the desirability of such a measure have been general, but almost always accompanied by a doubt as to financial possibility. A desire for further information was generally expressed and it is apparent that there is a growing interest in the subject."

(Concluded from page 48)

phone cannot remain connected when making capacity tests, for the telephone circuit would itself be charged and discharged, due to changes in potential conditions, and the test would be, of course, misleading. It is therefore necessary to avoid having the telephone key operated when making any ballistic test either grounded or metallic. The characteristic clicks received in the telephone due to the charge and discharge of a condenser soon become recognized when heard, and thus act as a guard against a false test.

That British Columbia's development is on a firm foundation is indicated by several items in the February issue of Telephone Talk, the magazine published by the B. C. Telephone Company. Since the company has caught up on its extensive plans of construction, as noted at some length, it is now occupied in many smaller works of progress, and that these are being proceeded with in different parts of the province shows that steady advance is being made. That 1913 was not a bad year with the telephone company is also shown by the net gain of 6,115 stations throughout the province, the net gain in Vancouver being 3,628 and in Victoria 1,392. Net gains were also made in January. Telephone Talk contains some fine full page illustrations of Victoria in the current issue, accompanying a write-up of the capital city. The article contains much information and will be of considerable interest, since much of the text has not appeared before in public print. A large number of items relating to the operations of the company show that it is a busy concern, and that considerable attention is always directed toward improvement of equipment and betterment of the service.

Motor Equipments in a Car Factory

The Canadian Car and Foundry Company Use Electric Power Throughout—Some Interesting Facts and Figures Regarding the Plants

One of the largest motor installations, if not the largest, in Canada, is that of the Canadian Car & Foundry Company, builders of freight and passenger cars of all kinds, at Amherst, N.S. Power is supplied by the Maritime Coal, Railway & Power Company, whose generating station is situated at Chignecto, eight miles from Amherst. The power is transmitted at 11,000 volts from Chignecto to Amherst, where it is stepped down to 2200 volts by the generating company and again for the most part to 220 volts by the Canadian Car & Foundry Company in their own transformers. Mr. Geo. T. Douglas is manager of the car works and we are indebted to him for some interesting information in regard to this extensive plant.

The plant of the Canadian Car & Foundry Company may, as far as electrical distribution is concerned, be divided into three parts, namely:—(1) the old plant; (2) the new steel car, bolster and steel fabricating shop; (3) the malleable iron foundry. The electrical equipment of these sections is described separately in the following article. No more conclusive proof of the general utility of electric drive could be advanced than the very extensive and complete system of motors installed in every part of this plant.

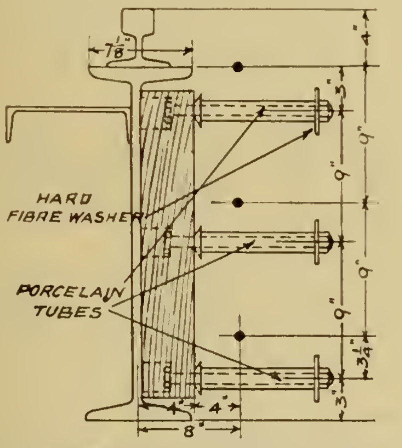

Fig. 1.—Method of supporting trolley wires for cranes.

The Old Plant

In the old plant there are three 40-kw. and three 75-kw. transformers which step the current down from 2200 volts as received from the Maritime Coal, Railway & Power Company's sub-station to 220 volts at which pressure practically all the motors are operated. The motors are supplied by four distinct circuits which it is the intention shall be controlled separately by overload automatic oil switches but the installation of this equipment has been delayed by rush of work as the company has recently been expanding at a very rapid rate. There is also a fifth circuit which takes current direct from the 2200 volt line. This circuit is controlled by an overload automatic oil switch and feeds two 40 h.p. motors which drive a matching mill, as indicated in the list of motors herewith.

In addition to the above power transformers there are also two 40-kw. transformers to take care of the lighting load, which consists of the equivalent of about 2,000 16 c.p. power lamps. The general lighting of the shops is done by 10 amp. flame arc lamps carried in groups of four on small auto-transformers, which reduce the voltage from 220 to 55. The arcs comprise thirty-six 18 hour lamps, and twenty-four 100 hour lamps. They have also six A.B. lamps, with economizers, to run on 220 volts and about 20 direct current A.B. arc lamps run from a 20-kw. d.c. dynamo owned by the car company.

In the woodworking mill where shafting and belts are many and ceilings low, they use four-light clusters with mazda lamps enclosed in opal globes. The current for lighting is distributed in three phase and carried along with the power wires on the same poles and brackets and balanced as nearly as possible in the various shop-loads. General outside yard lighting is accomplished by Benjamin four-light clusters with 100-watt lamps, and pole bracket lamps, controlled from the switchboard in four sections.

A complete list of motors, their capacity, voltage and uses is given herewith in Table 1.

Table I.—Motors in Old Plant

H.P.	R.P.M.	Machines Driven
20	1140	Band and circular saw, pony and buzz planer, wood lathe.
40	1130	2 circular and 1 band saw, 2 boring and 1 gainer, 1 emery wheel, 1 buzz and 1 pony planer.
40	1200	No. 90 Berlin matcher, 4 cut-off and 1 rip saw, also fan.
40	1200	
5	1650	2 cut-off saws.
40	850	Belt sander, also Berlin Invincible sander No. 49.
20	1130	Rotary blower.
29	1200	2 emery wheels, 1 buffer, 1 drill, 3 tumbling mills.
20	1200	6 lathes, 2 punches, 1 emery wheel, 1 planer, small shear, 1 drill.
20	1120	1 Thos. Collins Co. No. 66 shear.
15	1120	1 mortise machine.
12	700	1 18-in. cut-off saw, 1 14-in. rip saw.
5	1700	1 emery wheel, automatic re-saw grinder, 1 knife grinder, 1 mortise chain grinder, 1 re-saw lap grinder.
30	850	1 Berlin straight moulder No. 108.
10	1120	1 21-in. and 1 16-in. cut-off saws.
25	1140	1 5-in. re-saw.
1	1700	1 emery wheel.
3	1700	1 elevator.
15	850	1 planer, 2 drills, 2 shapers, 1 milling and slotting machine and 1 emery wheel.
15	850	6 drilling machines, 1 hack saw, 1 emery wheel.
15	850	1 planer.
40	1120	1 No. 7 Sheldon fan.
10	1120	1 fan, No. 3.
30	1130	2 headers, 3 threaders, 1 lag pointer, 1 emery wheel.
5	1700	1 elevator.
5	1600	1 hair picker.
10	1120	1 drill, 1 emery wheel, 1 band saw, 1 wood lathe.
10	1120	1 water tippling mill.
40	850	1 No. 40 double shavings Sheldon fan.
10	1120	2 threading machines, 1 hack saw.
50	810	No. 1 lever shear.
30	1120	No. 9 Buffalo fan.

15	850	1 tapping, 1 threading, 2 drilling machines, 2 shapers, 1 punch.
10	1120	2 pairs shears, 1 threader.
40	850	4 gainers, 1 mortise, 1 buzz and 1 surface planer, 2 circular saws and 1 band saw, 1 chain mortiser, 2 variety moulders, 2 tenon machines.
50	1140	Hot saw.
5	1700	Threading machine.
20	900	1 No. 2 garrison shear.
30	850	Transfer table.

Steel Car, Bolster & Steel Fabricating Shops

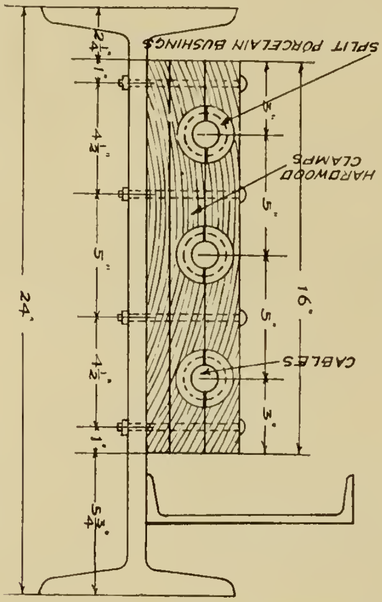

Fig. 2.—Method of supporting cables.

In the steel car, bolster and steel fabricating shop, current at 2200 volts, protected by Garton Daniels lightning arresters and isolation switches, feeds, through three pole, no voltage and overload automatic oil switches, three 100 kw. Westinghouse transformers, which deliver 220 volts, divided into four circuits supplying current to motors as per list, through four overload automatic oil switches. The compressor delivering air at 100 lbs. per square inch for use in the above shop is driven by one 375 h.p. slip-ring motor, which runs at 600 r.p.m., belt-coupled, and takes 2200 volts direct from the line through no voltage and overload automatic oil switch. The other motors operate at 220 volts. The switchboard for this shop consists of three marble slabs 36-in. x 48-in. and one 24-in. x 42-in. mounted on angle irons with a clearance of 3 ft. between wall and any cable or switch, leaving plenty of room for inspecting and working behind board.

The motor feed cables are 300,000 circular mills, stranded, rubber covered and double braided and are carried in the runway girders on which the overhead cranes run, secured by rack and split insulators every 20 ft. as per sketch, Fig. 1. This we think makes a very efficient job, as the cables are entirely out of the way of getting damaged. The motor feed wires are attached to the cables by clip connectors, to facilitate the quick isolation of shorts or grounds, and led in conduit pipes to three-pole knife switches with two sets of fuses, starting and running, which protect the motor and auto starter. All wires from conduit pipes to motors, switches and starting boxes, where exposed and liable to damage, are placed together and securely bound with marlin, laid on over a layer of strong canvas put on in the form of tape. This forms an effective cushion for any ordinary blow which might be expected from men inspecting on working around machinery. Switchboards are placed on the web of the I-beam columns supporting the building, which, with the box covering, are efficiently protected. All motors on the floor, or liable to damage from small rivets or bolts which are continually being thrown about in a shop of this description, are covered with a strong galvanized iron box designed with due regard to the ventilation of the motor.

The general lighting of this shop, which is 460 ft. x 160 ft., is efficiently carried out by 14 multiple arc lamps, 30 ft. from floor (to clear cranes), 110 volts, fed by a three-wire system 220 volts between the outers and 110 volts between middle and outers, and connected temporarily to the power transformers. The machines are lighted by carbon filament lamps with suitable reflectors. In this section there is also a private fire alarm system, with bells in most departments, all in series, and boxes in parallel. Passenger and dining cars are erected and wired here, the company being at present engaged on 15 Canadian Northern first-class passenger cars, installing the Stone system, including an independent train line circuit to facilitate these cars running in with other systems.

The following list, Table II., indicates the number, size, speed and uses to which the motors are put in this department:—

Table II.—Motors in Steel Shop

H.P.	R.P.M.	Machine Driven.
5	1700	Radial Drill.
30	900	Rotary Planer.
20	900	Mult. Drill.
5		Grinder Machine.
7½	900	Angle Shear.
30	900	Spacing Punch.
5	900	48-in. Gate Shear.
15	900	120-in. Gate Shear.
5	900	No. 2 Punch.
5	900	No. 2 Punch.
10	1200	B. Punch.
5	1200	Horizontal Punch.
7½	1200	36-in. Punch.
10	1200	Bend. Machine.
30	900	"G" Mult. Punch.
50	900	No. 9 Bulldozer.
50	900	No. 9 Bulldozer.
10	1200	"B" Punch.
5	900	No. 2 Punch.
5	900	No. 2 Punch.
30	900	No. 7 Bulldozer.
7½	1200	High Power Drills.
7½	1200	High Power Drills.

At the Malleable Iron Foundry the company have two distributing points, one in the old section, the other in the new extension. At the former, light and power are carried on three 10 kw. transformers taking current at 2200 volts and delivering 220 volts. In the new extension they have three 30 kw. transformers controlled by no voltage and overload automatic oil switches. These need a switchboard with four motor circuits. Motors are as per list herewith, Table III.

15	900	Rivet Machine Drills.
5	1200	Radial Drill.
20	900	Radial Drill. Not Installed.
40	900	Blower.
40	900	Blower.
5	1700	Shear Blade Grinder.
5	1700	Radial Drill.
2-10	1240	Vertical Drills.
10, 10 and 3		— Gantry Crane.
375	600	Air Compressor.
40, 37½ and 4		— 10-ton bridge crane.
40, 37½ and 4		— 10-ton bridge crane.

Malleable Iron Foundry

H.P.	R.P.M.	Uses.
10	900	Elevator.
15	900	Water Mills.
15	1200	Blower.
25	1200	Blower.
25	850	Tippling Mills.
10	1200	Grinders.
10	1200	Woodworking Machines.
5	1200	Woodworking Machines.

7, 2½ and 2 h.p. slip ring motors—5-ton crane.

The wiring is all open with the exception of where it comes down the walls to the starting switches and motors. The illumination is given by eight eighteen-hour 10 amp. flame arc lamps and thirty A.B. a.c. lamps with economizers to run on 220 volts. An experiment with 250 watt mazda lamps is being carried on here as dust and smoke are features to be taken into account in this department.

The wiring in the new cars is done in accordance with the C. N. R. specifications in steel conduit and Crouse-Hinds condulet fittings. The cars under construction will be fitted with five 4-light and two 2-light branch fixtures down the centre of the car and 4 vestibule lamps; also 3 saloon lamps wired on the outside roof of the car with junction boxes for each of the fittings. These are controlled by a six contact main switch, Stone type, which is part of the system. In the first position of the switch the vestibule, saloon and one light in each of the fittings are switched on; in the second position the rest of the lights in the fittings are switched on; the third position cuts out the lights and short-circuits the auxiliary resistance. The heater room and the switch locker lights are independent of the above switch and are operated by door switches protected by suitable fuses.

Everything connected with this system of lighting is of robust construction. The cells (Tonum) are 9-plate each, 10 13-16 in. x 5 9-16 in. x ⅜ in., of which there are 24 per car, each enclosed in lead lined teak boxes with two stout positive and two negative lugs. The company finds this system admirably suited to fulfil the hard usage of railroad conditions.

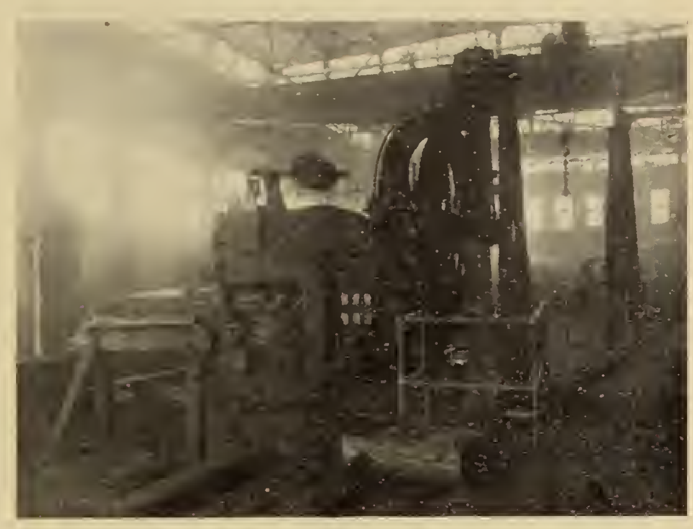

Fig. 3.—Electrically driven punch in steel shop.

Purchased Power and Coal Mining

By Mr. A, E. Rickards*

Purchased power affords so many advantages to the majority of bituminous coal operators that it will probably be only a question of time until most of them will be using it. In the meantime the coal operators must become acquainted with the merits of central station power, and the power companies must first learn how power is used to produce coal economically, and what advantages their service offers over power plants at the mines operated by the coal producer.

The Present Situation

The situation before the average coal operator is such that purchased power will supply a means to assist in solving some of his most difficult problems. These are:—

1—How to increase the production.

2—How to reduce the cost of mining.

3—How to keep the increase in the investment consistent with the increase in production.

Many operators realize that electricity applied to their mines will enable them to increase their output, but are holding off because of the investment required to equip a mine electrically and install generating apparatus. A mine now using steam power and mule haulage can change to electric power at a minimum expense if the electricity is purchased from a power company, since, by so doing, the greatest item of expense (the power plant) is eliminated. In this manner the tonnage can be increased with but a small increase in the capital account. With an isolated plant, the increase in the demand for power per ton of coal mined, as the underground workings are extended, frequently requires expensive alterations and additions in the power house. When central station service is used, additional power can be secured at any time.

*General manager, Industrial Engineering Company, Pittsburgh, Pa.

The power required by the average mine to-day is three times greater than the amount necessary ten years ago. With the growing demand for coal from individual workings, the cost to produce it has become greater and the capital necessary has increased still more largely, so that it is becoming increasingly difficult to finance increases or alterations in mine power plants. By purchasing power the tonnage can be increased, the production costs reduced and extensions can be made at a minimum expense. The idea of an isolated power plant is so firmly rooted in the average operator's mind, however, that he must first become acquainted with the possibilities of purchased power.

Power

Power is used in bituminous mines to operate pumps, fans, hoists, haulage and gathering locomotives, gathering reels, coal cutting machines and punchers. A general plan cannot be laid out that will apply to the electrification of all mines. Each type presents a problem in itself and must be specially treated as needed to cover its own peculiar conditions. The following is a general outline of the applications most commonly used.

Small pumps are driven by 250 or 500 volt direct-current motors. They are frequently operated only during the day, and the power supply is taken from the nearest trolley or cutting lines. Larger pumps in many cases are operated at night, or are operated continuously, and are commonly driven by 2,300 volt alternating-current motors. The fans operate continuously and are also driven by 2,300 volt alternating current motors. The principal advantage of this application for the large pumps and fans is that it allows the use of a smaller motor-generator set, the losses incurred in transforming alternating to direct current are eliminated, the motor-generator sets may be operated only during the day or at such times as the mines are in operation, and the total capital expenditure is much less. Haulage and gathering locomotives, gathering reels, coal-cutting machines and punchers are driven either by 250 or 550 volt direct-current motors.

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* Can. Man. Industrial Engineering Co., Pittsburgh.

Old Methods

The methods used in the early days to mine coal were very primitive. The operation generally consisted of digging a hole in the side of a hill at the outcrop. The coal was undermined with a pick and then forced down with wedges. It was then loaded into small cars running upon wooden rails, and after which the cars were pushed out to the surface by men. As the distances from the surface became greater the work of pushing the cars in and out became quite burdensome. Mules were then initiated into the mysteries of underground haulage. This faitful animal has become so firmly rooted in this occupation that it will be some time before he has become completely supplanted by more economical methods of haulage.

Pumps

The first power required in the early mines was for the water pumps. Unless the entries could be so driven that the mine was self-draining, more or less water would accumulate in the workings, which had to be pumped out to keep the mine in operation. This pumping was at first, and is still, largely accomplished by steam pumps, mostly of the reciprocating type. The steam is generated in a boiler plant located near the pit mouth and then carried underground to the pumps, through steam lines, which are frequently of considerable length. In the hard coal region it is a common experience to see a steam line carried over the surface of the ground for several thousand feet from the boiler plant and then disappear down a bore hole several hundred feet to a pump. Only very poor economy can be obtained under such conditions due to the large amount of condensation, drop in steam pressure and leaks. The reciprocating type of pump taking steam at full stroke is also inherently uneconomical in the use of steam. They often consume 120 to 130 pounds of steam per horse-power hour.

Compressed air is also used to quite a large extent in operating pumps. The disadvantage of this system is that it requires considerable compressor capacity; also it is not as economical as steam although it has the advantage of no condensation.

In the better class of mines the steam and the air pumps are being replaced by electrically driven pumps, thus effecting a considerable saving in the upkeep of the pumps and in the power consumption. The losses in electric systems are comparatively low and the maintenance can be kept low with very little attention.

For small pumps up to 25 horse-power, direct-current motors, geared to duplex or triplex pumps, are generally used because the source of power for them is taken from the nearest haulage or cutting lines. These motors are usually arranged for self-starting and require very little attention. The larger pumps are generally of the centrifugal type and it is the common practice to drive them with alternating-current motors. The practice in some of the large mines is to operate several small reciprocating pumps throughout the mine during the day, pumping into a common sump. The sump is then pumped out at night with large centrifugal pumps, this arrangement improving the load-factor to a considerable extent.

Ventilating Systems

The next department about the mine to require power was the ventilating system. In the early days the operators depended entirely upon natural draft or furnaces. Now a forced or induced draft produced by a power-driven fan has become the most reliable method of ventilation. A large percentage of these fans are driven by steam engine; however, the steam lines are often long and frequently uncovered, so that the steam losses are high.

Owing to the importance of the fan operation, any new method of drive must prove itself reliable before mine operators consent to its use. The electric motor has proven itself most reliable and dependable when applied to a mine fan. It has many advantages over the steam engine as it requires less attention, less repairs, consumes less power and the continuity of operation is more assured.

In applying an electric motor to a mine fan it is seldom possible to use a direct-connected motor owing to the inherent low speed of the mine fan. Belting, gearing and chain drives are the methods generally used, belting being the most satisfactory when the reduction is not too great. Both alternating and direct-current motors are used, the advantages being with the alternating current motor when purchasing electricity, as no transformation is necessary; also with this arrangement the direct-current power equipment can be shut down during a portion of the 24 hours. In some mines the fans are operated at the same speed 24 hours per day, while in others, they are run full speed during the day and at one half speed during the night, on Sundays and holidays. In this way considerable power can be saved. The method used depends upon the locality, and the amount of gas in the mines.

When direct-current motors are used for this work they are usually of the shunt type. By using commutating poles a considerable variation in speed can be obtained by field control at high economy. For constant speed fans driven by alternating-current motors, the squirrel-cage type is used. When two speeds are desired, a double-winding squirrel-cage motor is satisfactory. If a variation in speed is required, a wound-secondary motor must be used with resistance inserted in the secondary circuit to reduce the speed. With this application the economy at low speed is of course low, but as the power to drive a fan varies about as the cube of the speed, the actual power lost is not large at greatly reduced speeds. The motor and control for a mine fan should be as simple and reliable as possible. A properly installed motor-driven fan will operate over long periods of time with practically no attention, beyond an occasional inspection.

Haulage

As coal mines became better developed and the length of the haul increased, it soon become evident that some mechanical method of haulage must supercede the animal haulage, since the expense increased very rapidly, as the length of the haul became greater. Rope haulage was first tried, the rope being driven by a steam engine. There are many conditions to-day where the rope provides the best system of haulage. For the majority of conditions, however, the electric locomotive has proven the most economical and efficient method for both haulage and gathering. Our old friend the mule has been driven from the main haulage in the larger mines for some time and is now making his last stand at the gathering. The average period of service of mine mules is not over four years. The cost for feed, harness, veterinary services and stabling will average 50 cents per day. Adding the cost of the drivers to this, it is not difficult to show a considerable saving by the use of locomotives.

In extremely gaseous mines, compressed air locomotives are sometimes used to advantage. This type of locomotive should be used only when it is impossible to use the trolley type. Its cost of upkeep is very high. The storage battery locomotive, properly constructed and equipped, will probably be the solution for the gaseous mine. At present its high first cost is a little discouraging.

As mine haulage is in many respects similar to a railway system, the electric locomotive is equipped with much the same type of motor and control. In this country, direct current at 250 or 550 volts is the universal practice. The motors are series wound and in the later types are equipped with commutating poles, which greatly increase the reliability of the motor. This feature, to a large degree, also reduces the cost of motor repairs and consequent delays. The controller is of the drum type arranged for series and parallel operation.

Most locomotives are equipped with two motors, although three motors are sometimes used on large locomotives. Where a heavier locomotive is required than the rails can carry, two locomotives are coupled together and operated in tandem from one controller.

Gasoline locomotives are being tried for main haulage but so far have met with indifferent success.

Gathering

For gathering service two types of reels are used for collecting the cars from the rooms to which the trolley wires have not been extended. The cable reel consists of a single or double conductor cable wound upon a small drum and so arranged that a tension is kept on the cable at all times This cable supplies power to the locomotive and unwinds and winds up as the locomotive moves in or out of the room. The traction reel consists of a small motor-driven winch mounted on one end of the locomotive, and is used to haul cars out of rooms where it is not convenient to use an electric cable reel. This type of reel is best suited to mines where the rooms are worked to the dip and the grades are too severe for locomotives.

For gathering service locomotives ranging from 3.5 to 8 tons are used while for main haulage the weights run from 6 to 20 tons.

Rope Haulage and Hoists

The rope haulage system, previously mentioned, is used on grades ranging from 0 to 90 degrees. In practically all cases they were first operated by steam, although quite a number of gravity systems are in use. Where power is purchased or the hoisting outfit is located some distance from the steam plant, an electric motor is used. A large number of steam haulage systems and hoists have recently been changed from steam to electric drive. For small hoists and haulage, both alternating and direct-current motors are used, depending on local conditions and the kind of power available. For large haulage units or large hoists of slow or medium speed, the alternating-current wound secondary motor is used with a liquid or magnetic controller. For large high-speed hoists, a separately excited direct-current motor is used, taking power from a special motor-generator set, usually equipped with a heavy flywheel, to equalize sudden loads.

Mining Coal

The actual operation of mining coal consists in undermining the coal at the floor and then shooting down the coal above by light charges of powder placed in holes drilled between the under-cut and the roof. As previously stated, in the early days before the use of powder became the practice, the coal was wedged down. This was a slow and very tedious process. The undermining was first accomplished by hand with ordinary mine picks. In fact a large part of the coal to-day is obtained by pick mining.

Among the simplest mechanical means for under-cutting the coal is the compressed air puncher. It consists of a reciprocating chisel operated by air. The operator directs the reciprocating chisel against the coal and an assistant shovels back the fine coal produced, so as to leave a clear opening. This under-cut is about 16 inches high in front and four inches high at the rear and is cut back from four to five feet. This wedge shaped cut greatly assists in bringing the coal down with light powder charges without breaking it up too fine.

The compressed air plant to furnish air for these punches is usually located outside the mine near the boiler plant. Motor-driven compressors are operated very successfully with purchased power. They furnish a steady load for a synchronous motor, which in turn can be used for power-factor correction. Whenever possible, the electric drive should be located in the mine because of the inefficiency of transmitting compressed air. Portable compressor plants are sometimes used to help out the main plant and keep up the pressure at the far end of some of the pipe lines.

A combined electric and air puncher is in use which gives the advantage of electric transmission of the energy and pneumatic operation of the puncher. This really can be classed as an electric cutter, giving a wedge shaped undercut which is not obtained with a chain machine.

Auxiliaries

There is often a considerable amount of power in use on the outside of a mine. This power consists principally of auxiliary hoists, chain haulage, crushers, shakers, elevators, washers, pumps, machine shop, etc. In many cases these auxiliaries are driven by individual steam engines, whose principal virtue is that they give fairly high continuity of operation. These auxiliaries can be easily taken care of in a much better and more economical way by substituting electric motors for the steam engines. In most cases alternating-current motors can be applied, which greatly simplifies the power system.

Lighting

In mines not using electric power no attempt is made to light the outside workings. It has been found however, that some illumination is necessary at all switches, cross-overs, partings, pumps and underground fans. The incondescent electric lamp has proven the best and cheapest method of providing underground illumination.

Conclusion

It has been the experience of those mines which have changed over from steam to electricity, that a great saving has been effected and the output has been increased. Of course, after a mine has changed over, the operating force will require a little time to adjust themselves to the new condition. The saving and increase in the output by use of electric power, makes itself most manifest when power is purchased from a central station. The initial investment, and the worry and care attendant on the operation of a sub-station is very much less than with an isolated plant. This is so to such an extent that an operator once using purchased power will rarely, if ever, consider going back to his own power plant.

It is not an uncommon thing, when investigating the power conditions at a mine with an isolated plant, to find that the power generated per ton of output is as high as 12 to 14 kw.-hr., with a corresponding cost for power running from 15 to 25 cents per ton. With the intelligent use of purchased power the consumption should not average higher than 2 to 5 kw.-hr. per ton and the total cost for power should not average higher than 3 to 7 cents per ton of output. In changing over to central station power the greatest care should be exercised in selecting the proper power system and power equipment, to see that the particular arrangement is adopted which will give the best results under the conditions prevailing in the mine.

Testing of Telephone and Telegraph Lines*

By Mr. T. H. Nicholson

Testing Metallic

As before stated, and as will be seen from Fig. 24, the volt-meter is normally across the line, or rather in series with it and the testing battery, and without the necessity of operating any keys, so its relation to the test circuit, and to the line under test must be as shown in Fig. 25, where only the contacts of essential keys are shown. For convenience sake this order of contacts will be maintained, the number given with each contact to refer to the associated key.

Under the conditions obtaining in Fig. 25 no deflection is obtained, indicating that unless the line is actually open, there is no leakage or metallic connection between L_1 and L_2. The next step is to determine if the line or instrument is open or not. This is done by means of a ballistic test, or test for capacity. No change is made in the testing circuit except to reverse the L_1 and L_2 by means of the reverse key No. 3, which alternately charges and discharges any condensers that may be across the line. The charge and succeeding discharge causes a momentary deflection of the voltmeter to the right, the amount of deflection depending on the capacity of line or condensers on it. With a commercial voltmeter of 30 volts range a deflection of about four volts will be obtained on the charge, and slightly less on the discharge. The connections and conditions of the test circuit when making this test is as shown on Fig. 26, where the dotted lines show the reversal of circuit brought about with key No. 3. If this test results in producing a momentary deflection to an extent corresponding to the number of condensers on the line then we know the line is closed through them.

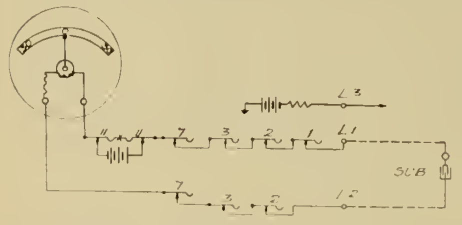


Fig. 25

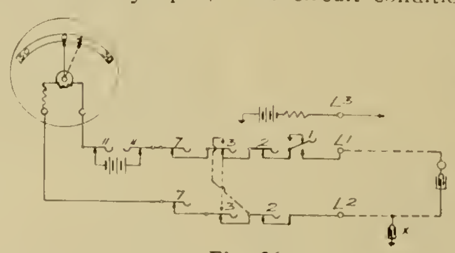


Fig. 26.

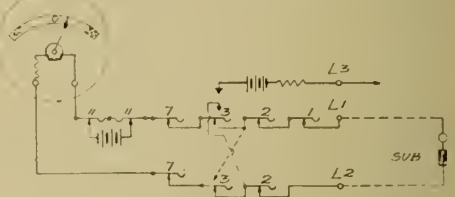


Fig. 27.

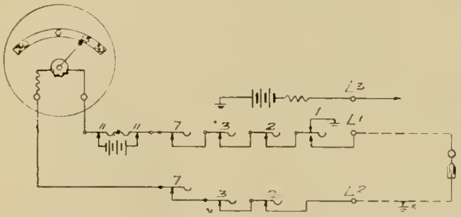


Fig. 28.

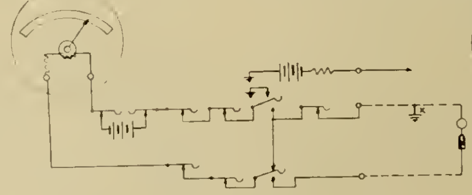
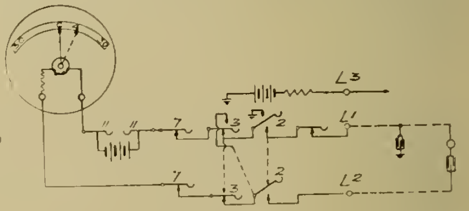


Fig. 29.



Fig, 30.

Testing L_2 for ground.

The next step is to test the sides of the line for cross or ground and to do this the "Test L_1" and "Test L_2" keys are alternately operated. Fig. 27 shows the results of operating key No. 1 "Test L_2" and also shows an imaginary ground on L_2 for the purpose of showing how the ground is discovered. On operating the key a deflection is immediately noted, and for present purposes this can be assumed to be due to a ground on L_2. Following the circuit on the figure the testing current can be considered as flowing from the negative pole of battery through the voltmeter, over L_2 to the ground at X, through the earth to the ground applied at key No. 1 and back to the positive pole of the battery and thus completing the circuit causing the voltmeter deflection noted. The deflection as noted in the figure is given as 15, which, if the voltmeter is 1000 ohms, would show that the ground also measures 1000 ohms. This, of course, includes part of L_2, and the resistance of the cross to ground itself. A method of determining these values has already been given, and it will be further dealt with in the section on trouble location.

Testing L_1 for ground.

To test L_1 for ground, key No. 2 is operated, and the same general results are obtained, but with a rearrangement of the test circuit by the operation of the key. Fig. 28 shows the circuit conditions when this key is operated, and shows how the circuit is reversed and grounded in one operation, thereby leaving the voltmeter and battery in same relative position to the line as before. The current path through the circuit, line and ground can be readily traced from the figure.

Testing L_2 for capacity.

Having now tested the sides of the line for leakage, and finding none, the grounds shown in the figure being for illustration only, we next proceed to test them for capacity, that is—in the case of local lines—to ascertain if there are any stations on the line with grounded bell circuits. This test is made in exactly the same way as a test for leakage, with the addition of operating the reverse key, as in the case of metallic capacity test, to produce a charge and discharge of any condensers that may be connected from L_2 to ground. Fig. 29 shows how this is done. The "Test L_2" key No. 1 is operated as in Fig. 27, and in addition the reverse key is shown with its full connections. It is obvious that a condenser at "X" will now be charged and discharged through the circuit thus set up, and the amount of capacity or number of condensers thus determined. Fig. 30 shows the same test for L_1 and the same conditions and results apply, with, of course, the different circuit caused by the operation of key No. 2 necessary for testing on L_1.

During any of these tests, except those for capacity, the tester can have his telephone connected at all times, for, referring to Fig. 24 the telephone is shown connected onto the voltmeter side of all testing keys, and, providing there is a condenser between it and the test circuit, no effect will be had on the tests from it, and it is very convenient to be able to listen on a line while testing, and thus be able to observe what would otherwise escape notice, such as intermittent induction troubles, etc. It is evident, however, that the tele-

(Concluded on page 42)

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Electric Railways

More Car Barns For Vancouver

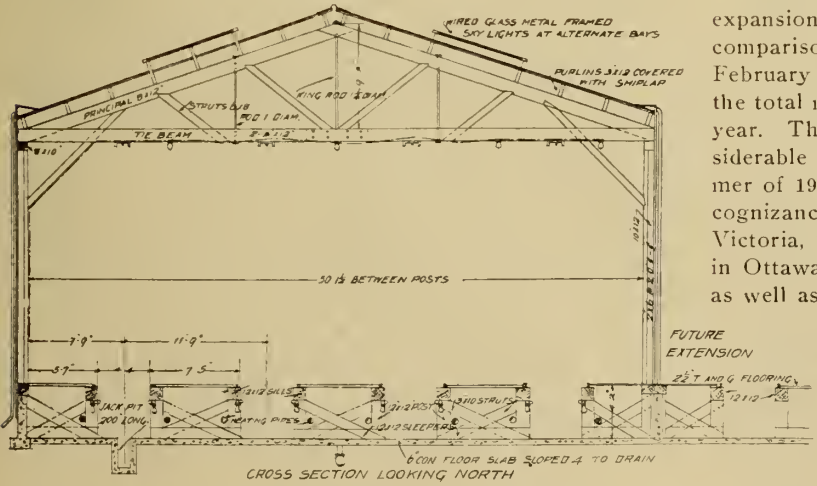
The British Columbia Electric Railway Company have recently placed in service at Vancouver a new car barn. At the present time the company have a barn in the centre of the city and another in the Mount Pleasant section. The new car barn is located in the western portion of the city, the company thus having barns distributed at several points, enabling them to economically arrange for the operation of early and late cars as well as quickly provide for special service in any section of the city. The new barn is 400 feet long by 52 feet wide and will accommodate 64 of the company's city cars.

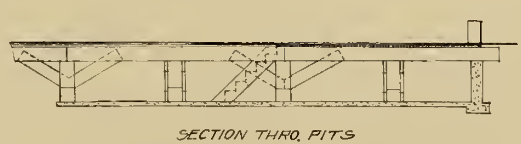
In the construction of the car barn the entire site was excavated to a depth of 4 feet 8 inches below the street level. The excavation was then covered with a concrete floor 6 inches thick and concrete walls 9 inches thick were built up to the street level. The floor from each wall has a slope of one inch in six feet towards the centre line, thus providing good drainage. For one of the tracks a jackpit three feet deep and one foot wide extends under 200 feet of track, this being the only break in the concrete floor. Upon this concrete base, along the line of each track, 12 by 12 inch posts were placed at 8 foot centres. These posts supported 12 by 12 inch stringers upon which the rails are laid at the street level. In this way easy access is possible in all parts of the barn to the under side of the cars stowed therein. The subgrade was generally hardpan but in some places where the base material was not so good additional sills were placed under each of the 12 by 12 foot posts.

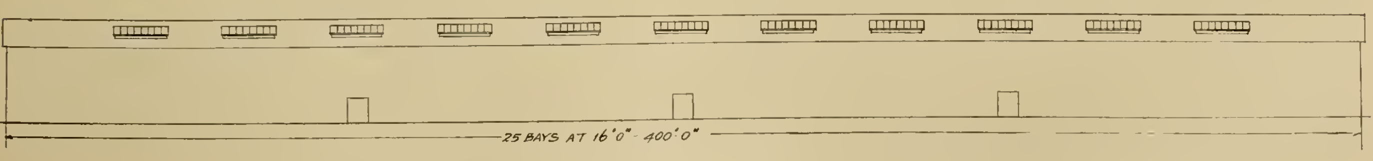
At the present time the walls above the street level are boarded with 2¾ inch shiplap on which is placed galvanized iron. This form of construction is followed as it is expected in the future to build other units, possibly all of reinforced concrete type, at the same place; the shiplap boarding will then be one side of the form for the reinforced concrete wall. The roof truss is of wood construction and is of simple type, the roof of the building being also of galvanized iron with wired glass skylights every 32 feet.

The building is generally lighted by 100 watt metal filament lamps so arranged as to provide one lamp to each 192 square feet of floor area. The timber construction, in the pit, supporting the rails is completely wired, sockets being placed here and there for use in repair work.

The building is equipped with a complete sprinkler system for fire protection as well as with five monitors mounted on towers just outside the building. These towers are about 20 feet high and support 6 inch stand pipes. The monitors have a range of 70 feet with a 2½ inch nozzle and the towers are placed 50 feet apart. The building is also equipped with a complete low pressure steam heating plant. The car barn was built according to the plans prepared by the company's architect and erected by day labor.







Sections and elevation of new car barn of B. C. E. R. Company, Vancouver

Electric Railway Statistics

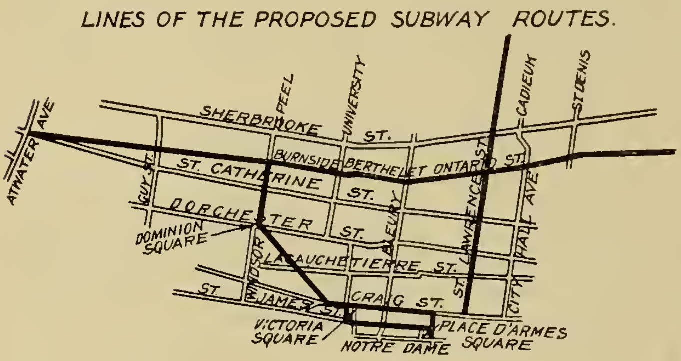
A report of the Department of Railways and Canals regarding railway statistics of the Dominion of Canada for the year ending June 30, 1913, is just to hand. Some interesting data is given as to number of miles of track, stock capitalization, etc. The report places the total number of miles, computed as single track, of Canadian electric railways at 1,869.6 as compared with 1,723.51 the previous year, an addition of 146.12 miles during the year.

These figures scarcely do justice to the electric railway expansion in Canada during the past year as is shown by a comparison of these figures with those published in the February 1 issue of the Electrical News. As shown there, the total mileage in Canada is 2,080, an addition of 241 for the year. The discrepency is accounted for partly in that considerable activity was shown during the last half of the summer of 1913. However the government report has not taken cognizance of some 36 miles new road in Vancouver and Victoria, 20 miles in Edmonton and considerable extensions in Ottawa, Port Arthur, Regina and to the N. S. & T. lines as well as minor extensions by other systems. Neither does the government make any report on the Brandon Municipal System, the Edmonton Interurban Railway, the Saskatoon Municipal or Toronto Municipal systems.

Judging from all the figures the Electrical News has been able to obtain the year 1913 constituted a record in electric railway developments with the prospects for the coming year even brighter.

Montreal Underground

Mr. G. Janin, chief engineer, and Mr. McLeod, railway engineer, of the city of Montreal, have submitted to the Controllers a report on the transportation problems of the city. A short time ago the Montreal Tramways Company and the Canadian Autobus Company presented rival schemes for subways and autobuses to the Council, and these were referred to the city engineering department. The report is a very exhaustive one, and points out that traffic conditions have now reached such a stage that the providing of additional car tracks, the changing of routes, and increasing the number of cars will only secure temporary relief for a few months or a year or two, when the city will again be confronted with the problem of improving the service. The report, therefore, includes a series of recommendations for the construction of underground rapid transit lines, to be operated in conjunction with the surface cars, and the combination of these two to be supplemented by such motorbus service as may be deemed necessary; the widening of two or three streets to be used as business boulevards and afford new arteries both for local car traffic and the increasing volume of vehicular traffic.



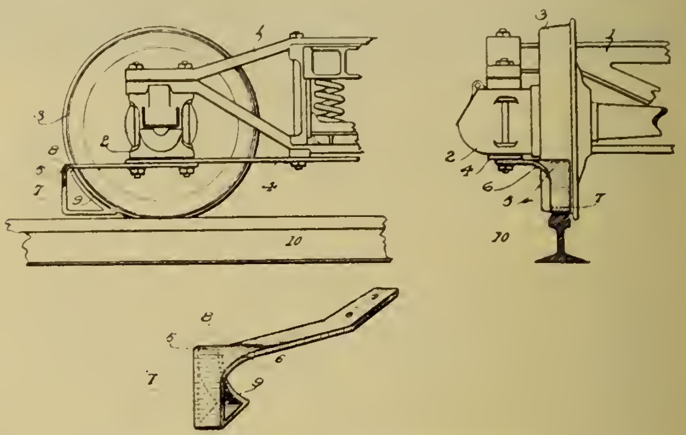
Proposed subway rates for Montreal.

Owing to the extension of the city and suburbs, the rate of travel has since 1899 increased 310 per cent. or more than twice the rate of increase in population. The result is that there is an almost unbearable congestion of cars at the rush hours. The engineers discuss in detail various routes for subways, and recommend a subway running east and west from Frontenac street to Atwater avenue, via Ontario, Burnside and Luke streets, a distance of 3.45 miles, at an approximate cost of $8,800,000; a subway from Burnside street to Viger Square, via Craig and Latour streets, Dominion Square, and Peel street, 1.63 miles, approximate cost $4,800,000, to serve the down-town district; and a subway under St. Lawrence Boulevard, north and south, 3.45 miles, approximate cost $7,000,000. The total mileage is 8.21, and the estimated cost $20,000,000, exclusive of widening or extending streets and equipment and plant.

The engineers suggest that tunnels should be constructed under the Lachine Canal, and also that considerable changes in the routing of the existing surface lines will be necessary, in addition to the construction of new surface lines, especially in the outer wards of the city.

A Safety Wheel Guard

A new safety wheel guard is being tried out by Mr. M. O. Robinson, joint manager of the Fort William and Port Arthur street railway systems. The idea of the guard is to absolutely prevent any person or obstruction from getting under the wheels either from the front or from slipping in at the side of the car. The guard is hung from any convenient place either on the car truck or on the car body and goes down in front of the wheel clearing the rail by about one inch, then back to within ½ inch of the wheel, then up, taking the radius of the wheel to a sufficient height to insure protection. The design may be better understood from the accompanying sketches. In making this guard 2¼ in. and ½-in. iron bar is used. The device is the invention of Mr. A. A. Blennerhassett, of Fort William.



Showing design of new wheel guard.

Ottawa Electric Railway Annual

The annual report of the Ottawa Electric Railway Company for the year ending December 31, 1913, showed that, for the first time in the history of the company, the gross revenue exceeded $1,000,000, amounting to $1,041,282. During the year operating expenses have been sixty per cent. of the gross revenue, a very satisfactory figure, which, indeed, has always been the case with this company, the percentages since 1900 varying between 57 and 66. The net earnings available for dividends were about 19½ per cent. A 12 per cent. dividend was paid with 3 per cent. bonus.

The report adds that the new work carried out and completed during the year was as follows:—1,000 h.p. sub-station on Centre street; 1,000 h.p. sub-station on Nelson street; extension of tracks to Ottawa south from Wilton Crescent, forming a loop on Sunnyside, Seneca and Glen Ave.; Preston street extension from Somerset street southerly and re-arrangement of tracks on Broad street; double tracks on Queen street from Bank to Elgin street; an additional track on Crichton street from Beechwood Avenue to Charles St. and a loop by way of John street; the 4,200 h.p. steam turbo-generator referred to in last annual report is expected to be ready for operation early in the spring; a large amount has been spent in improving the tracks and rolling stock as well as other properties, and the company is now in a better position than ever to handle any business that may offer.

Selkirk, Man.

The electric light rates of Selkirk have been reduced from 10c per kw.h. to 8c per kw.h., discounts remaining as before. The Selkirk electric system is managed municipally, power being purchased from the Winnipeg Electric Railway Company.

Railway Conditions Governing Electrification

By Roger T. Smith, M. I. E. E. *

Circumstances have decreed that up to the present time British electrical engineers have to go to the Continent or to America for examples of railway electrification for other than urban or suburban services. Now that the Institution proposes to have a series of papers on the subject of railway electrification it seems desirable to deal in the first of them with some of the railway conditions in this country which may account for our apparent lack of enterprise. Each country has its own railway conditions and economics, and because main-line electrification is economically sound or experimentally desirable in parts of Europe and the United States it does not follow that it may be equally right for us. The dearness of money and the demands of labor make it at the present time very difficult, if not impossible, for British railways to spend money in experiments on electrification other than on a small scale.

In a country like ours, possessed of a system of steam railways which have cost more to build than railways elsewhere, a third generation of men inheriting the traditions of the past is being trained to work them. It seems reasonable that if any change from steam to electricity is proposed by electrical engineers they should first endeavor to provide something which will at least do what steam will do, next try to give electrically what steam cannot give, and finally do this in such a way as will result in improved financial prosperity to the railway. It is far easier to change things than to change the habits and inherited instincts of large bodies of men, and electrical engineers have not only to show railway managers that they can haul the railway traffic either better or more cheaply than is done today by steam, but that they can first of haul traffic at least as well as it is hauled by steam, and fulfil most if not all of the functions of the steam locomotive in the manner in which those who work the traffic have been accustomed. Any proposal, otherwise economically correct, that will suddenly atter the way in which large bodies of men have been used to handle traffic in the past is not sound engineering or sound business unless the resulting gain is very considerable.

At the Paris meeting the Institution had the advantage of discussing not only certain applications of electric traction to French railways, but also a reasoned analysis on the position of electric traction on the railways of the United States as it appeared to a French engineer.

As an outcome of that discussion, and with the view of suggesting some of the things in railway working which steam now does, and are already done or will have to be done as well or better by electricity, it is convenient to divide railway service into three groups. These three groups correspond to entirely different conditions as far as traction is concerned.

1. Urban and suburban passenger services.
2. Fast passenger services.
3. Fast or slow goods and mineral service.

It is not pretended that this exhausts the types of services for which it is profitable to consider electric as compared with steam haulage. For instance, the electrification of terminals is not included, nor incline working, nor the marshalling of passenger and goods trains, nor the working of goods and mineral shunting yards. Shunting conditions only will be referred to later. The above division is sufficient, however, for the purpose of such generalization as is alone attempted in this paper.

1. Urban and Suburban Passenger Service

Urban passenger service.—A purely urban electric service is a thing so much apart, and has been so excellently engineered as far as London is concerned in its underground railways, that it is not necessary to discuss it in any detail here, since it differs only in degree from suburban service. Steam traction for underground services is out of the question in the twentieth century; quite apart from any special advantage that electric traction may possess over steam traction in the matter of services with frequent stops averaging about half a mile apart. All underground passenger haulage must be electric.

Suburban passenger service.—A suburban passenger service exists to enable a working and business population to live outside the town in which it works. In this country suburban transport has mostly grown haphazard with the population and its extent is governed by the time which people consent to spend in the train between their homes and their business occupation. Excluding outer suburban service the limit may be taken to be about 45 minutes each way. The greater the distance covered in that time, that is to say, the higher the schedule speed(average speed including stops) of the train the more chance has the railway of creating new traffic.

If a railway possessing a suburban system equipped with permanent way, platform accommodation, and locomotives designed for a certain time-table finds this equipment outgrown by the traffic, it is obvious that it must increase the number of coaches run in a given time. To do this several courses are open.

First, it may double or treble the number of tracks and increase both the number and length of its platforms, thus increasing the number of passengers carried without necessarily increasing the journey schedule time. In the past this has been done on several of the London railways with suburban services, the cost of widening the line and rebuilding the stations having been enormous.

Secondly, the railway may retain its permanent way and stations and with them the maximum length of its trains, but increase their schedule speed by using the biggest type of steam locomotive permitted by the load gauge for runing comparatively light suburban trains. This has been worked out and tried experimentally for the Berlin suburban service, but comparatively little has been done by locomotive engineers in this country to design a steam locomotive purely from the point of view of the rapid acceleration of a light suburban train. It has been done on the Great Western Railway and also in the case of the rail steam auto-car, which, with high adhesive weight, does possess fairly rapid acceleration.

Thirdly, the railway may electrify, which solution is commending itself to many of the railways in this country with congested suburban services. With electrification a maximum of 48 trains an hour can if required be run each way during the rush hours while employing existing stations and tracks. That it is possible to run trains so close to each other is chiefly due to signalling by track circuits, but full advantage of the possibilities of running up to 40 or more trains per hour by the use of track-circuit signalling can only be taken by trains having rapid acceleration and very rapid deceleration. With tracks and stations (and hence also the

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*Part of paper presented before the Institution of Electrical Engineers.

train length) remaining as before, the number of passengers carried per hour has in many cases been doubled by increasing the schedule speed fifty per cent., while improved signalling has at the same time made it possible to increase by fifty per cent. the maximum number of trains per hour.

The characteristics of urban and suburban services for which electric traction is suitable are a dense or fairly dense service of not less than, say, five trains per hour each way, up to forty and more per hour each way, with station stops varying from less than half a mile apart up to 1½ miles apart. With services less dense than the minimum, and with stops further apart on the average than the maximum here given, the advantages of electric traction, if they exist, are special and not characteristic.

The essential element which gives to electric traction its advantage over steam under these conditions is the motor-coach train. The train is made up either entirely of motor coaches (as in the western suburban system of the French State Railways) or of motor coaches and trailers. The number of motor coaches must be such that the weight on the driving wheels available for adhesion is not less than 25 per cent. of the total train weight. It is more often 33 per cent., and may be 100 per cent. The making up and driving of such trains has been rendered possible by multiple-unit control.

With the motor-coach train it is quite easy to have such an adhesive weight as will permit of a tractive effort, over and above that required to haul the train against resistances, sufficient to accelerate it during the notching period at rates up to 1½ miles per hour per second (2.2 ft. per second per second), while the rate of deceleration is usually increased up to 2 miles per hour per second. Such a rate of acceleration is not often justified, and a more characteristic example may be taken from one of the London suburban services where trains weighing 175 tons are accelerated during the notching period at 1.7 ft. per second per second to give with 20-second stops a schedule speed of 17 miles per hour, the station stops averaging half a mile apart. The adhesive weight is 46 per cent. of the train weight, and the energy input while accelerating is 1,300 h.p. Within the load gauge of this railway no steam locomotive could be built of such a power. If it could be built it would have (in order to give the necessary adhesion and power) four times the weight of the electrical equipment, which is distributed over eight axles.

The Multi-unit train

Other advantages of the multiple-unit-controlled motor-coach train, as has often been stated, are first the doubling of terminal accommodation by halving the number of signal and locomotive movements, and secondly the ability to make and break up the motor-car and trailer units of which the maximum train is composed to suit the traffic.

No piece of apparatus is more fitted to accelerate a train rapidly than an electric motor with a series characteristic. The series-parallel connection of the continuous-current motor can give without opening the circuit two running speeds for each definite load after acceleration is complete, while in the single-phase motor voltage regulation can give as many running speeds as are desired.

For any suburban service requiring 20 trains per hour to bring morning passengers in and take evening passengers out of a city, tracks and terminal accommodation must be set apart exclusively for the purpose. It is not overlooked that two of the most important and successful suburban electric services of the Lancashire and Yorkshire Railway and the Newcastle suburban service (if such it may be called) of the North-Eastern Railway, run for some distance over main lines used by steam trains. The maximum number of trains per hour is 12 each way in the case of the Lancashire and Yorkshire service, and 6 each way in the case of the North-Eastern service. The North-Eastern electrification is something more than a suburban system, while the Liverpool-Southport service is a very successful experiment in the creation of new traffic, which makes it typical of the best sort of suburban service.

In general, however, it is safe to say that until it is necessary to devote terminal facilities, station accommodation, and at least two tracks entirely to a suburban service, it is very doubtful if electrification is the only solution of the congested traffic problem, although it may prove to be the best solution. Most of the suburban services into and out of London already electrified or in process of being electrified are run on tracks distinct from the main line, and such a service becomes a thing apart. It can be electrified on any system which best suits its conditions, and the method may be quite different from any other method which may subsequently be desired for main-line electrification.

Under such conditions—and they are exemplified on the largest scale in Europe by the suburban lines leaving the St. Lazare Paris terminus of the Western French State Railway system—the results of suburban electrification all the world over show that there are really no fresh engineering problems to be solved. On both sides of the Atlantic there are numerous examples all more or less on the same lines, two new systems out of London, one north and the other south of the Thames, being now in process of equipment by the London and North-Western Railway and the London and South-Western Railway respectively. Compared with steam haulage the measurements of power are so simple and cheap that when the traffic department asks for any reasonable schedule the engineer is not only able to design his equipment to work to it, but can within very close limits what it will cost in power and what it will cost in maintenance.

The Financial Side

Passing from the engineering to the economic side, the question of the electrification of a suburban system has become for a railway company purely one of finance. Essentially it resolves itself into a question as to whether the fares charged for the service, even with the additional traffic obtained, can give a reasonable return, or any return at all, upon the new and old capital, after the cost of working has been provided for.

When electric tramways were developed in this country for urban and suburban services they competed directly with railway steam services in many large towns. As an example, when London started its electric tramway service on the south side of the river the suburban steam service of the Brighton Railway decreased from eight million passengers to five million passengers per annum. On electrifying its lines not only did the railway regain this loss in the first year but it has since added to its traffic steadily; at fares, however, lowered by the tramway competition.

It must be remembered that the tramway uses the streets and pays only for its construction, for part of the paving, and for a part or the whole of necessary street widenings. The railway has paid for the land—often acquired compulsorily at an exorbitant price—and has had to put on the land costly permanent way and structures. Usually a railway company is the largest ratepayer in any parish through which it passes, and is often the largest ratepayer in any town. It may therefore be called upon to pay rates to a municipal body on which it is not represented, in order to keep up part of the roads used by a competing tramway. If the municipal tramway is run at a loss the railway helps to pay the losses of a competitor whose presence reduces the railway fares.

The tramway in turn is now menaced by the competition of the motor omnibus, which pays nothing beyond the patrol tax for its right to use the roads in order to compete with both railway and tramway.

The management of a railway has to decide in each individual case whether, considering its handicaps in the cost of its road, which one of its competitors has not to meet at all, and its high rating, which may go to assist the other competitor, it can make enough money out of competitive fares to justify the added cost of electrification.

Even when it cannot make the development of its suburban traffic pay directly it may still pay the railway as a whole considered only as a feeder to the main line, or urban and suburban traffic as a whole may pay if the latter goes far enough out into the country. This latter type of suburban service is best illustrated by the Liverpool-Southport electrified system on the Lancashire and Yorkshire Railway.

From Liverpool to Hall-road, 7⅛ miles away, the average distance between stops is ⅞ mile and the schedule speed is above 25 miles per hour. This is probably the most rapid suburban service in existence. From Liverpool to Southport is 18½ miles, with an average distance between stops of 1 1/3 miles, but beyond Hall-road this average is only a little under 2 miles. The schedule speed of stopping trains is 30 miles per hour. The maximum instantaneous input to the train is nearly 2,000 h.p., and the power consumption for the stopping trains to Hall-road is about three times the power averaged over the whole service of stopping and express trains and idle mileage. This is an excellent example of how a service if extended far enough out and combining express with stopping trains reduces the energy used over the whole system to a reasonable figure. The long-distance fares have to make up for the far greater cost of the short-distance stopping service.

Not only have electrical engineers completely solved the engineering problem of frequent service with short distances between stops, but the cheap and simple measurements of electrical quantities have taught railway companies for the first time how costly the constant stopping and starting of a train must be as compared with running at high speeds with infrequent stops, whatever form of power is used for traction.

It is not that suburban electric traction costs an unreasonable amount, but that circumstances make the revenue from such service unremunerative. Suburban fares have been falling steadily, and at the present moment it is safe to say that everybody in London and its suburbs is being carried at too low a fare to give proper remuneration to any form of traction which, in addition to rates and taxes and government duty on some fares, pays for its road and the right to use it.

From the report of the London Traffic Branch of the Board of Trade for 1912, particulars of London urban and suburban traffic can be obtained and compared with the returns and estimates of the omnibus and tramway traffic. From these returns it appears that if the suburban systems of the main-line railways running into London are left out of account there has on the whole been no increase during the last three years in the number of passengers carried by the underground railways of London, all of which are electric. Quite considerable increases have taken place in some lines—the District carried 7¼ per cent. more passengers in 1912 than in the previous year—but other lines lost some of their passenger traffic, and the total number remains stationary at about 436,000,000 passengers per annum. The average fare was a trifle above 1½d. The purely London traffic of the main-line railways—inclusive of their suburban traffic—is estimated for 1912 as 250,000,000, which is a decrease of 1¾ per cent. on the traffic of the previous year.

The London tramway traffic in 1912 is estimated at 800,000,000, which is a decrease of 3 per cent. on that of the previous year, while the omnibus traffic amounted to 550,000,000, or an increase of 37 per cent. on the 1911 figures. Greater London traffic as a whole increased by 125,000,000 passengers in the same period, which is 20 per cent. less than the omnibus increase, every other form of traffic having declined except that on the underground railways, which remained stationary.

A Parliamentary Committee has been investigating the problem of the city, circular, and suburban services in Berlin, and it reported at the end of 1912. Fares have been reduced to such an extent that in that year they averaged ¾d. per passenger, or half the average unremunerative fare in London. With steam traction these fares do not pay working expenses, and no capital charges whatever have been paid of late years on about £12,000,000 spent on the Berlin railways.

In 1913 money was voted for the electrification of the city and circular railways, but the suburban electrification is not to be dealt with at present. The point of interest is that, after electrification, fares all round are going to be raised to such a figure as will not only pay working expenses but capital charges (interest and amortization) on the old and new capital.

Like most other industrial working costs, that of running a suburban service depends on certain standing charges which taken as a whole do not vary, or hardly vary, with the service given (upkeep of permanent-way equipment, management, rent, rates and taxes, and station traffic expenses) and a charge varying with the service catered for (rolling-stock, repairs and wages, running wages and electricity). In a particular case the ratio of standing to variable charges for running a small suburban service for a year was as follows: Standing charges unaffected by the number of trains 60 per cent., variable charges 40 per cent., and of this 40 per cent. electricity formed three-fourths.

If the cost of electricity can be reduced by fifty per cent. the total working costs may be reduced by one-quarter, which shows the importance of cheap electricity. This is a particular case where the cost of electricity was high, and as a rule its percentage effect is not so great.

What is wanted to make urban traffic on electrical lines pay is either an increase in the fares, which is achieved abroad by zone fares, or the ability to purchase electrical energy delivered to the conductors at say ¼d. per kilowatt-hour. Competition may prevent the former. Is there any chance of obtaining cheaper electricity?

The Supply of Electric Energy

The generation of electrical energy and its supply is a business in itself. In many cases it has not in the past been possible for railways electrifying suburban services to buy electricity from outside, but wherever they have been able to do so the saving of the initial cost on which capital charges have to be met and the saving to the railway of the management of a business organization that is very different from its other organizations is a great gain. In general, the addition of a load which in the case of a heavy suburban service may continue during 18 or 20 hours out of the 24 with an annual maximum demand load factor of from 45 to 55 per cent., should enable a supply authority with a light and power load to offer a railway company such a price as would leave no question as to its acceptance. It is scarcely necessary to point out, however, that the purchase of electrical energy has not been the policy of the majority of the railway companies. Some of them have had no chance of buying, but those like the North-Eastern and London, Brighton and South Coast Railways who have purchased electrical energy have no reason to regret it.

To sum up the situation with regard to suburban electrification as it appears to the author, the electrical engineer is in a position to inform his railway very exactly what the initial and working cost will be. The management have to decide what the financial result will be with the existing and expected traffic, which has to pay working and capital charges on the new capital before earning a dividend on the old. Competitive fares are so low that the process is generally discouraging except where a new traffic can be created in districts from 10 to 30 miles from the terminus. The cost of electric working is important, but as Mr. Insull has recently pointed out the cost of money may be still more important, and the raising of fresh capital for anything that is not certain to swell the dividend is a very serious matter indeed at the present time when the credit of British railways stands so low.

2. Fast Passenger Service

When the condition of frequent stops and short distances between them is left and the question of main-line passenger services as run by steam locomotives is considered from the point of view of electric traction, the problem alters completely.

To give some idea of the effect of stops it may be mentioned that in a particular steam service a 7-coach train weighing 187 tons, including a dynamometer car, required an average draw-bar horse-power of 277 when hauled by a steam locomotive at an average schedule speed, including stops, of 40 miles per hour, the stops on a nearly level road being 23½ miles apart. The same train, run at an average schedule speed of 27 miles per hour and stopping on the average every 5½ miles, required an average draw-bar horse-power of 284, or practically the same. The time taken to do the same distance is in the ratio of 1 to 1½, so that the energy used for the stopping service for the same distance is 50 per cent. greater than for the fast service. The condition of the track, wind, and weather make such great differences in the power, than any generalization from individual tests is dangerous, and such tests are too costly to be made often; but such an instance will serve to indicate how increasing fourfold the number of stops in a given distance makes the cost of hauling a slow train much greater than the cost of a moderately fast service with few stops.

A good deal of experimental and pioneer work has been done on the Continent and in the United States in electric locomotive design, but the engineering problems which have to be solved in this country before fast passenger electric services can compete with existing services have hardly been considered.

In a paper such as this, only intended as a preface to more detailed papers and to stimulate discussion, it is impossible to do more than touch in general terms on some of the difficulties.

The steam locomotive is so designed that with earlier and earlier cut-off as the speed increases, practically constant outputs are obtained for the same load. The timetables of British railways imply maximum speeds of between 70 and 80 miles per hour. The resistances to train movement increase in proportion to the speed raised to the 5/3 power, so that for trains running with infrequent stops a locomotive with constant output has sufficient reserve of power at low speeds, over and above that required to overcome resistances, to give a moderate acceleration (up to the limit imposed by the adhesion of the coupled wheels) and to maintain the train at any speed (determined by the regulator and the cut-off) up to the maximum speed with that load.

As compared with the electric locomotive the steam locomotive is handicapped by the distribution of weight due to the length of the boiler. In the former, from the shape and size of the motors it is possible to get a greater ratio of adhesive to total weight than in the latter, especially if every axle is driven. In general for fast passenger service the acceleration of the steam locomotive is limited not only by the boiler capacity but by the maximum adhesive weight on the coupled driving wheels.

For the 4—6—0[*] type locomotive, the adhesive weight being absolutely limited by structures to 60 tons, and by usual practice to 56 tons, the starting draw-bar effort is limited to about 16 tons. From the start until the driving wheels are moving at about 50 revolutions per minute—say about 12 miles per hour for the engine under discussion—the maximum draw-bar pull is 12 tons, determined by the adhesion.

Such a passenger engine can haul a train of 450 tons on the level at the highest speeds called for in this country and, unassisted a train of 300 tons up a gradient of 1 in 50. The maximum length of the train is in general limited by the minimum length of the station platforms, and without radical changes in station structures no heavier trains can be run except for occasional "rush" traffic. To haul such a train, a constant-output locomotive is satisfactory, and the control of the output and speed by the regulator and the cut-off is so complete that the steam locomotive can run at any speed below its upper limit for the load hauled.

With the exception of certain three-phase locomotives in Italy and America, all the electric locomotives built have been equipped with motors having series characteristics. At any given voltage the series motor has one speed for each definite load. Series-parallel control with continuous-current motors gives two speeds, and with certain numbers of motors three speeds for continuous working can be obtained.

The problem of getting the adhesion necessary to prevent the slipping of the wheels when starting is, in general, possible with appreciably lower axle loads than for the steam locomotive, while for the same tractive effort the advantage in total weight is always in favor of the electric locomotive. Since the series motor can be overloaded momentarily 75 per cent. above its hourly rated capacity, while for adhesion purposes if necessary every axle can be made a driving axle, very great starting torques are possible, but on British railways they would be not only useless but actually harmful, exceeding the draw-gear strength. Unlike the case of the multiple-unit train, the adhesive weight may be only 12 or 14 per cent. of the total train weight, and the strength of the draw-gear limits the draw-bar pull after starting to 12 tons. But with an increase in speed the torque of the series motor falls off so rapidly that above 60 miles per hour (where difficulties begin with steam locomotive design) no electric locomotive yet built for hauling only such maximum loads as obtain on our railways could give anything like 1,100 h.p. at 70 miles per hour.

The Economic Side

One object of the series winding is to saturate the field of the electric motor at starting, and provided the field is saturated no extra current through the winding is of any use. The field can equally well be saturated by separate excitation, which opens out the possibility of a shunt characteristic with variable speed for the continuous-current motor, voltage variation already providing several running speeds with the single-phase motor.

The very interesting experimental line equipped by the Lancashire and Yorkshire Railway for 3,500-volt continuous-current electrical working between Bury and Holcombe Bridge has two motors on its motor coaches permanently in series and a motor-generator for providing current at 100 volts for the auxiliary service of control, brake pump, lighting, and heating. The same principle could be used for exciting the field, and it is suggested that such a method of obtaining the series characteristic at starting and the shunt characteristic for higher speeds is worthy of consideration.

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[*] There is no uniformity in different countries in the symbols used for types of locomotives. This paper follows American and British steam practice, thus 4—6—0 indicating a leading 4-wheeled bogie, 6 coupled driving wheels and no trailing pony or bogie. 2—8—0 indicates a 2-wheeled leading pony, 8 coupled driving wheels and no trailing pony or bogie. 4—4 + 4—0 indicates an articulated locomotive with leading and trailing bogies and 4 driving wheels in each half.

Turning from the engineering to the economic side, and assuming a suitable electric locomotive has been built, a very rough estimate may be made of the cost of working, more with the purpose of showing the direction in which economies are desirable than of giving any figure that can be used for estimating purposes.

The annual cost of a steam passenger locomotive, averaged over all the different types in use on a railway carrying passengers, goods, and minerals over not less than 2,000 miles of route, and hauling its own locomotive coal, may be taken to be £825 for such items as do not vary with the mileage run or only vary to an extent which will not affect this first approximation. These include capital charges (which are taken at 6 per cent. for interest and obsolescence), administration and management, wages of drivers and firemen , oil and small stores, maintenance repairs and renewals. To this is to be added the cost of coal and water, varying more or less directly with the mileage, which for passenger service may be conveniently taken as the train mileage. The annual cost of coal at about 9s per ton per 10,000 B.t.u. averaged over the whole working together with the cost of water may be taken to be £350, giving a total for the year of £1,175 inclusive of capital charges. This is a mean for all locomotive types working an average passenger mileage of 10,000,000 train-miles per 1,000 miles of route. During the year a passenger engine may be expected to run between 25,000 and 30,000 or say 27,000 passenger train-miles, so that the mean cost for locomotive expenses (including locomotive capital charges) per train-mile will be 10½d.

Of the above sum of 10½d. per train-mile 3d per train-mile will represent the cost of coal and water. After the coal strike in 1912 the cost per ton went up 2s., but neglecting its present high but fluctuating value, and taking the cost of the best English coal used at 12s 6d per ton, to which 3d per train-mile corresponds, cheap coal in this country is one of the factors making against railway electrification. The cost of coal burnt in a large modern generating station producing electricity for hauling trains by an electric locomotive is less than half the cost of coal for doing the same work in a steam locomotive. In America coal costs about the same as in England, but in France the 3d per train-mile for coal and water would be at least 6d, and in Switzerland and Italy 9d or more. The influence of the cost of steam locomotive coal in non-coal-producing countries, more especially where water power is available for generating electricity, becomes obvious from this form of analysis without claiming any great exactitude for the actual figures given.

In the paper on 2,400-volt electrification already referred to, Mr. Hobart works out the efficiency of a Pacific type 4—6—2 steam locomotive between the heat value in the coal in the tender and the work done at the draw-bar, and correcting his constants for the results obtained with the largest modern English locomotives using coal of a calorific value of about 15,000 B.t.u. per lb., the value of this efficiency is 3¼ per cent. Allowance is made in this figure for the coal used in firing up and remaining in the firebox at the end of the journey. He also quotes the actual efficiencies obtained between the heat value in the coal in the bunkers of a large modern electric generating station using similar coal and the work done at the drawbar of an electric locomotive for similar work, and finds it to be 6 per cent. after his constants have been altered to suit English conditions. Working from these efficiencies the result is obtained that the cost of electricity per passenger train-mile is about the same as the cost of coal and water per passenger train-mile hauled by the steam locomotive, provided that electricity can be bought at 1/3d per kilowatt-hour.

Weight for weight the electric locomotive costs about twice as much as the steam locomotive, but for the same adhesive weight the electric locomotive weighs some 30 to 40 per cent. less than the steam locomotive. Electric repairs and renewals cost less, and the net result is that the annual cost of the electric locomotive will be in the neighborhood of £1,250 per annum, assuming the same rate for capital charges.

But while the passenger steam locomotive only runs on the average 27,000 train-miles in the year, spending 75 per cent. of the time out of active service, the electric locomotive, which need only be in the shops for one month out of the twelve, will not spend more than fifty per cent. of its time out of active service. The electric locomotive can run at least 40,000 passenger train-miles per annum. There is not much experience to go on, and that experience has been wholly obtained in other countries. The suburban working in London where electric locomotives are used is so restricted that no figures are obtainable which can be compared with steam working. Multiple-unit motor-cars run 45,000 to 50,000 miles per annum.

If these figures are accepted, the cost per train-mile with the electric locomotive (including locomotive capital charges) will be 7½d, always assuming that electrical energy can be bought at 1/3d per kilowatt-hour.

Only an Approximation

It must again be emphasized that these figures can only be considered as a first approximation to the truth, and they will differ for different railways. But assuming that for a railway running 10,000,000 passenger train-miles per 1,000 miles of route, the conditions enabled electric locomotives to run 40,000 miles annually, so that a saving of 3d per train-mile was secured by electrification, there would be a possible annual saving due to electrical working of £125,000. If capital charges (interest and amortization) were 6 per cent., this would represent the charges on a capital of £2,100,000 per 1,000 miles of route, or £2,100 per mile of route. This sum would certainly not cover the corresponding electrical equipment of the line on an overhead system, inclusive of contact wire and structures, distributing cables, bonding, and sub-stations.

The only items for which a reduction in costs may be expected are the cost of electricity and the capital cost of electric locomotives. No great reduction in the cost of the former can be expected so long as railways generate their own electrical energy, as there must be a diversity of load and generation on a scale far beyond railway requirements to secure an appreciable reduction in price. If electrical energy could be bought at ¼d per kilowatt-hour, and the electric locomotive could be made for £50 per ton, the cost per train-mile in the above estimate would be reduced to about 6d.

The problems in front of the electrical engineer who would compete with the passenger steam locomotive are therefore first to design an electric locomotive that will do what the steam locomotive does at high speeds; secondly, to reduce the cost of the electric locomotive (which will come about when there is sufficient demand for it); and thirdly, to be in a position to buy electrical energy at something approaching the ⅛d per kilowatt-hour which forms Dr. Ferranti's ideal.

Contract has been awarded by the Winnipeg Board of Control for tower footings along their new transmission line between Winnipeg and Point du Bois.

The Dealer and Contractor

The Old and the New Code

At a recent luncheon of Toronto "Jovians," Mr. H. F. Strickland, chief electrical inspector of the Hydro-electric Power Commission, gave a talk on "The Old and the New Code." Mr. Strickland spoke as follows:—

In a limited time it is impossible to go thoroughly into all the details of such an extensive question as electrical inspection of a province the size of Ontario. I will, therefore, confine my remarks to a short, comprehensive outline of the plan of inspection and the probable method of enforcing it.

We all know that it is necessary to first of all formulate proper laws and such as can be regarded by those who know as just and practical. Then when the law is passed it is of little or no use unless it is enforced. In the case of the old inspection there is not very much the matter with the rules or what we might term the old law. The chief weakness with these old rules is the fact that they do not specifically cover the life hazard. The old rules were made almost entirely under the supervision of the Fire Underwriters and kindred associations whose one interest is the prevention of loss from fire, and I think that we can all safely say that the little National Code has been a familiar figure in the electrical world over this entire continent and is a by-word amongst the electrical fraternity, and that there was little wanting in it so far as was required to get a pretty satisfactory job if carried out to the letter. So much for the departed friend. We always like to speak well of those who have gone before, and I think I am not going too far when I say that the book of regulations now produced by the Hydro-electric Power Commission will be the recognized standard of electrical installation work in this province for a good many years to come, with, of course, such amendments and additions as may be necessary from time to time owing to fluctuations in the conditions. At this point it would be well to remark that the National Code when it first appeared was not anything like it is at the present time. The Hydro-electric Power Commission's Rules as they stand to-day have adopted a good deal of the matter originally in the National Code, for the simple reason that after having made a most exhaustive inquiry the Commission decided that there was nothing that would suit local conditions better than the main substance of this little code. The text of the code was carefully read through and re-edited, making considerable change in the phraseology of certain rules, eliminating a great many repetitions, adding a number of other rules and deleting a few unnecessary ones, and finally the whole substance of the book was re-classified and put in much simpler and practical order.

The national code was written in the form of a suggestion throughout, owing to the fact that the Fire Underwriters have had no legal power of enforcing their requirements other than by an increase of insurance rates which often were detrimental to the interest of the companies bidding for insurance business.

As the Hydro Power Commission's Rules were to become a law in the province it was necessary that the book be re-edited in such a way as to make all requirements positive, clear and concise, which I think is conceded by most people who have studied it carefully to be the case. The question of enforcement is now the next problem to deal with. The law requires that municipalities must appoint electrical inspectors and also has invested the Commission with power to approve of the selection which any municipality may make. I am not at the present time at liberty to make any statements as to what the Commission may do or what further legislation they may ask for, but I have reason to believe that as time goes on they will continue to receive the necessary amendments to the Act to obtain the best results. In the meantime the municipalities have been notified throughout this province that they are expected to pass the by-law giving their municipality the power to regulate electric wiring and the use of electric current within their boundaries. The commission have prepared a uniform by-law which has been printed and is sent to all the different municipalities, which they must copy and pass, thereby relieving them of much loss of time, expense and worry in drawing up a varied assortment of by-laws throughout the province, some of which might be useful and others perhaps useless. The form of by-law which has been prepared by the Commission is printed on the back of the Rules and Regulations, and covers all the points which are liable to present themselves, for the present at least. The commission have power to amend this by-law, add to it or change it as they may in their wisdom consider advisable.

Much has been done

In a great many of the important cities in Ontario the by-law has already been passed and electrical inspectors appointed and results are already forthcoming, so that it is likely before the end of the year there will be in the neighborhood of one hundred municipalities from Ottawa to Fort William carrying on a municipal system of electrical inspection. The work of the different inspectors throughout the province is subject to the supervision of the Hydro-electric Power Commission, that part of the work directly connected with electrical inspection being handled by what is known as the Rules and Regulations Department, which at the present time is in charge of the speaker, but like all other departments in the commission is subject to the authority of the chief engineer of the Hydro-electric Power Commission, so that what limited knowledge I may have of the work generally is further enhanced by the engineering experience and advice of the chief engineer. The result of this system should ultimately be very satisfactory to all parties concerned, inasmuch as the system of inspection, the enforcement of rules, the general interpretation thereof and the final settlement of all disputes will be uniform, as they must ultimately revert to the Hydro-electric Power Commission for adjustment. One of the chief difficulties experienced in the country to the south of us is that while they have many civic inspection bureaus the interpretation and enforcement of the rules is largely affected by the personnel or idiosyncracies of the inspector, resulting often in confusion and a duplication of devices to suit the whims and peculiarities of any particular inspector who may fancy that he is divinely inspired to enforce the rules just a little better than somebody else. However, your chief inspector does not make any claim to any superior inspiration, but will carry out the orders of his employers to the effect that the rules be enforced in their full broad meaning, that everybody get an absolutely fair and unprejudiced decision and that cheap substitutes for approved material and workmanship be not tolerated, and so long as I have the honour to serve the commission I will take great pleasure in endeavoring to carry out this policy to the best of my ability.

In a word, the entire system of inspection is under the control of one final authority, namely, the Hydro-electric Power Commission, resulting in a uniform and legal administration of electrical inspection laws. Now, in anticipation, this condition is ideal, and I hope before long that the realization of it will be all that can be expected. We all appreciate the difficulties which confront the electrical contracting interests, such as, that people who are endeavoring to carry on a first-class business and handle only approved material are confronted with competition from irresponsible amateurs who, under the present dispensation, are able to do anything they like. This fact is well known to all people engaged in the electrical fraternity, both to the contractor and jobber without any further elaboration. Already old code rubber covered wire is becoming a drug on the market, and in several municipalities connection has already been refused by local inspectors, to installations where old code wire had been used. This may seem a trifle hard at first, but the contractors had been fairly warned that new code wire only would be accepted, and if they choose to play with fire they will get their fingers burned.

The Life Hazard

The new regulations of the Power Commission, in addition to the rules pertaining to the fire hazard, contains also sufficient extra safeguards to prevent, as far as reasonable, electric shocks or danger to the unskilled person who is inadvertently brought in contact with electrical apparatus or fittings, voluminous productions have been produced and many hours of thought expended on fuses, and the fusing of circuits, so that they cannot be improperly or over fused. The result of all this deliberation has been the production of cartridge fuses with different types of alteration, with the object of making them non-interchangeable, but, all said and done, there is no rule heretofore to prevent anyone from fusing up his main cut-outs with gas pipe or over-fusing it beyond the melting point of the wires they are pretending to protect. Under the Hydro-electric Commission regulations all main fuses must be enclosed in a sealed up metal enclosure and proper warning placed on the box that if these main fuses are tampered with or the seal broken the offending parties will be liable to prosecution. I think I am pretty safe in saying they will be prosecuted. This at least insures that the installation will be protected so far as the main fuses are concerned, and if amateurs or others choose to over-fuse their branch circuits they can only go so far and no farther. There is nothing in the rules to prevent the consumer from having an auxiliary main fuse if he desires it, but he will soon learn to know that once he goes past the safety point he will blow his main fuses, and it will likely cost him something to have it replaced.

There is one point in connection with the whole of the electrical inspection methods which is of the utmost importance and one which I wish at this juncture to emphasize very strongly. That is, the prevailing notion amongst a great many electrical contractors and also an impression which a great many of these people give their customers, that the new regulations will greatly increase the cost of electric wiring. I wish to bring out this point very strongly, because it is one of great importance to central station operators, both municipal and private. In answer to this I would quote the statement of one of our best known electrical central station operators in Canada, who in writing to us recently used the remark that even should proper regulations somewhat increase the cost of electric wiring I am firmly of the opinion that it should be safe at any cost. When this statement is thoroughly digested the force of it becomes more and more apparent. When one is called upon to enter the home of some unfortunate family whose husband and father has been suddenly carried out from their very midst in the prime of life through an unfortunate accident owing to defective electrical installation, the truth of this statement is brought home in a most forcible and grevious manner. I have now been in three homes during the past twelve months where just such an accident has occurred, and in each case the electric wiring was defective and could have been originally installed for practically nothing more in the way of expense than was expended in doing work in the way in which I found it. The cost of plumbing was at one time considerably less than it is now, but who amongst you would be willing to return to the old system of plumbing with its absence of proper vents, syphons and traps that was so common before disease and death was the means of bringing about better and more sanitary arrangements.

The object of the wiring rules and regulations is to ensure to the unskilled and untrained people of the community a reasonable protection against shock and fire, and again, to encourage skilled and bona fide electrical workers that when they give an estimate on doing work in accordance with the specifications laid down in the Hydro Rules and Regulations that their trade will not be interfered with by the work of unskilled people who in the absence of any proper system of inspection are at liberty to do pretty much as they like. I want to say also at this juncture that wiring contractors who make the cry to their customers that the wiring regulations are greatly increasing the cost of wiring are only admitting that they have heretofore been giving their customers small measure for value received. To prove this statement it is only necessary to mention that there is little or nothing in our regulations requiring any greater expenditure of time and material than was originally suggested in the rules of the National Code. The chief difficulty is that in one case our regulations will require that the work be done in accordance with the letter, whereas in the past there has been no way of enforcing the requirements except in a few centres where there was inspection by the Fire Underwriters.

Extra Cost is Small

As a further illustration of this argument we will take the case of a moderate sized home, say a ten roomed house. To wire a house of this size with knob and tube wiring with an ordinary outfit of switches and the number of outlets which would be ordinarily found in a moderate sized home would cost between $60 and $85, varying somewhat according to whether the switches were flush or surface, but taking $75 as a fair price it will just cost about 75c more to do this job in accordance with our Rules and Regulations as against the National Code requirements. Now, gentlemen, I ask whether 75c or even $1.75 is a serious matter when the safety of your family is at stake. Is there any man who would grudge 75c to save his wife from shock, fire or possible injury? yet, in the face of these facts we have already had some contractors, where electrical inspection is being rigidly enforced, raising the cry that it is greatly increasing the cost of wiring, their chief object seemingly being to make the system of inspection unpopular and to get back at the inspector.

There is an element of inconsistency through all this.

On every hand the cry goes up among the electrical contractors for good inspection. I therefore say to all those engaged in the business, chiefly in the outlying towns, now that we are giving you this inspection do not encourage such talk but make the municipal councils of your municipalities feel that the institution of a system of electrical inspection is for the welfare of the citizens at large. I feel that I have now taken up enough of your valuable time and I hope that in bringing this short address to a close that I will leave you all like the man who leaves the table feeling hungry, that is to say, that he can come back again and enjoy a little more at the next sitting.

The Consulting Engineer and the Contractor

By Mr. F. A. Vaughn

In considering the relation of the consulting engineer to the contractor, the element that "looms up" larger and more prominently than any other is that described by the magical, justly popular and perhaps much abused word "Co-operation." While there may be pleasant business, technical and social relations between the contractor and the engineer, the most essential relation by far is that of co-operation in the common service for the benefit of the customer of the contractor and the client of the engineer—of co-operation in order to secure for the individual, who pays for the services of both contractor and engineer, an installation of which all three may be justly proud.

You will, I believe, agree with the above analysis when I recall to your mind the many important advantages that accrue, not to the customer alone but to the contractor as well, by the type of co-operation referred to above. Every one of you would undoubtedly rather do good work than slovenly; rather use good material than poor; rather put in a complete and thorough installation in which you can take pride as well as make a profit, than to put in one in which you can only make a profit; you would also rather work against fair and equal competition than be subject to rash and unreasonable competition from irresponsible concerns.

With the above assumed premises established, the way is opened to the proper relation of the engineer to the contractor.

Every consulting engineer, who is worthy of his profession, naturally sets himself an ideal and a code of ethics that will build for him a reputation which will command the confidence of his clients in whose interests his efforts must be used in the broadest sense. He therefore must, by experience and other educational means, fit himself to know, for any particular client's installation and condition, what are the best and most dependable materials and methods. By specifying there in detail, the engineers will put all contractors on an equal basis, because they know in detail what is expected; will eliminate the possibility of "skimping," as well as the necessity of "playing safe" by excessive bidding to cover ambiguous points; will compel and popularize the use of good material and high grade workmanship because of its merits; will demonstrate, as a disinterested advisor to his client, the advantage and economies of good work, thereby establishing the proper relation between just compensation to the contractor and good value to the client; and will in general establish higher standards, the general adoption of which will eliminate the demand for cheap materials and cheap labor and by the establishment of these conditions will be establishing what is best for the client, the contractor and the engineer. This, then, is the co-operative part which the engineer should play in this triple relation. The contractor can do his share in the co-operation by giving the engineer the benefit of his experience and his conscientious efforts to comply with the specifications, to the end that the installation is praiseworthy and the client is satisfied that the money he has paid to both the engineer and the contractor is well invested.

By co-operation such as above described, the quality of engineering installation in the community will be raised and good workmanship will be at a premium as it should be; and this will all be accomplished without the efforts of the contractor, except, of course, the necessary and legitimate effort of doing good work according to specifications. Without the engineer in the field, clients are apt to ask and expect a contractor to "engineer" his installation, as well as to construct it, thereby forcing the contractor to labor, worry and expense that he probably is not willing to do, organized to do, or paid to do. His function is to construct, according to the requirements of the client, expressed through the specifications of the engineer, just as the engineer's function is to plan and specify, but not to construct.

It may be suggested that the engineer is an unnecessary factor because there is usually an architect connected with the work who is, or should be, able to specify all of the engineering features of an installation as well as the structural, architectural and artistic ones.

It is believed a little consideration will show that, in these days of wonderfully intricate, complete, comprehensive and often elaborate buildings which an architect is called upon to construct, and the tremendous strides and rapid advancements of all branches of applied sciences or engineering, an architect who devotes much of his time or energy to keeping sufficiently in touch with the engineering features of his installation is sacrificing the architectural side of his work which is the channel along which his very best efforts should progress, or else he is not devoting enough time and ability to master the engineering side; for the engineering branches involved in a modern installation—electrical engineering, mechanical engineering, heating and ventilating engineering, illuminating engineering, etc.—are highly technical and specialized branches which require different talents, character of mentality and foundations, than those found generally in men naturally equipped to be architects.

So in this co-operative scheme it is necessary to include the architect, and the same spirit of helpfulness for a common good should prevail throughout. The requirements of the client can now be thoroughly, intelligently and accurately specified in detail so as to insure a thorough understanding of them by the contractor without the necessity of imposing on his time or abilities; and it should be noted that the more minutely the specifications are written, the better insurance the contractor has that any competing concern will be required to furnish exactly what he himself has figured and the more assurance there is of equivalency of purpose and intention.

Specifications do not Specify

Specifications which do not specify are like laws which do not carry with them their own interpretation—they require the interpretation of the courts or other authority before they are really valuable. An architectural specification asking tersely for a "home to house a family of four" would appeal to all of us as highly inadequate and ridiculous; yet it is hardly more inadequate than an engineering specification for an "A.C., 220 volt generator of 250 kw. capacity" although it is believed the latter example is no exaggeration. In either case the client would get something which would perform the function he desired, in a way, but how satisfactorily is entirely unknown and indeterminate.

Brevity and terseness are much to be desired characteristics of any composition written or spoken; but unfortunately it is usually impossible, in a matter involving so many details as an electrical installation, to state those details in

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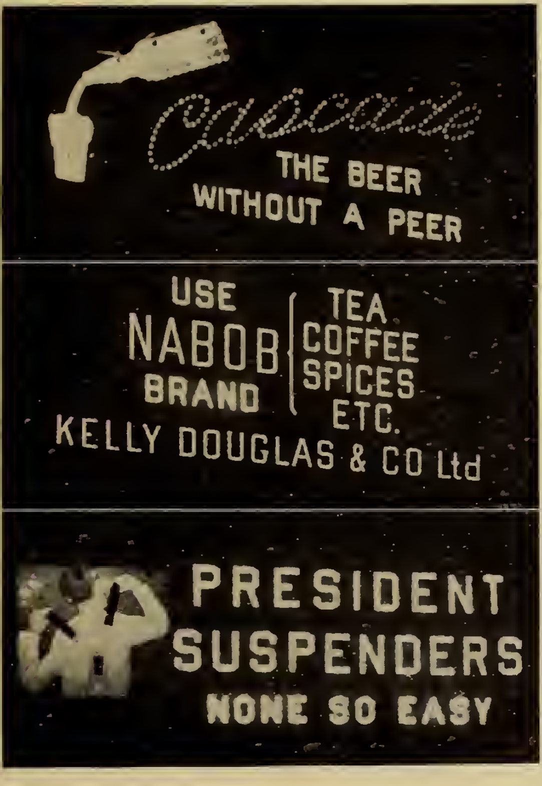
Delivered before the Annual Meeting of the Electrical Contractors' Association of Wisconsin.

such definite and exact way that there can be no uncertainty as to what is required, and yet make that statement a brief one. The only safe way, therefore, to secure what is required is for the engineer or architect to specify minutely all details of the installation, even though to do so involves great trouble and expense. By such exact and complete specifications, not only is the client assured of getting the best installation for the money expended, but the contractor is protected against unscrupulous persons bidding for and probably securing the contract for the work.

A consulting engineer is therefore to be regarded as a co-worker, in the truest sense of that word, with the contractor. The whole influence of any consulting engineer who measures up to his profession is in the direction, first, of protecting the reliable and high-grade contractor from unfair and cut-throat competition; and second, to educate the client to the wisdom of putting in a first-class installation, thereby enabling the contractor to get a fair profit for first-class work. A more general recognition of this ground of common interest between the contractor and the consulting engineer would do not a little to improve the conditions in the contracting field.

Electric Signs in Vancouver

The remarkable growth of business in Vancouver during recent years has lead to a great increase in the use of electric signs by local merchants and the city's rapid rise to the position of an important seaport and popular tourist centre has attracted the attention of firms which employ electric signs as the medium for conducting national advertising campaigns. Nowhere throughout the city is the display of electric signs more in evidence than on Hastings and Granville streets, the two principal business thoroughfares which at night are ablaze with the glow of hundreds of signs of every conceivable description. The types of sign in use at Vancouver at the present time are divided into three classes, viz., "spectacular" signs, which illustrate some movement by automatic action; "flashing" signs in which there is intermittent display of either the whole sign or part of it, and "constant" signs with fixed light. What is considered to be the largest "spectacular" electric sign in Western Canada and the most successful in Vancouver, has been erected on the roof of a tall building on Hastings street east. This sign, Fig. 1, advertising a local brand of beer, measures 30 x 60 feet and is equipped with 625 four c.p. tungsten lamps for letters, outline, etc., and three 100-watt tungsten lamps with reflectors. During its operation the sign remains dark, except for the reflected light from the 100-watt tungstens on the neck band and label of the bottle. The tungsten lamps then show first, full bottle and glass outline flashes; second, stream starts, bottle empties, glass fills; third, stream disappears and glass foams; fourth, the word "Cascade" in red flashes on, followed immediately by the words in white "The Beer" and an instant later "Without a Peer," then all out and repeat.



Figs. 1, 2 and 3

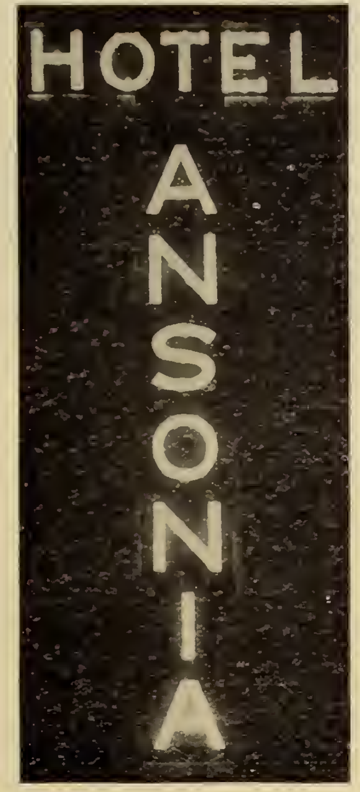


Fig. 4. Typical T sign

The immense flashing sign owned by the wholesale grocery firm of Kelly, Douglas & Company affords a good illustration of the type it represents. The size of this sign is 48 x 90, see Fig. 2, and the number of lights, 779 5-watt tungstens. The color scheme consists of red for the name of the firm and the word "Nabob" with the bracketing design in green, and the balance of the sign in clear. While operating, the left side is "constant" covering the words "Use Nabob Brand"; the right side comprising the words, "Tea, Coffee, Spices, etc.," is "flashing," the words being shown one by one until the entire phrase is complete, then all out; all on and repeat.

The President Suspender sign, forming the Vancouver unit of a national advertising project, is displayed on Hastings street east. This sign is of a combination type, and measures 18 x 42 feet, Fig. 3. The bulletin to the left is illuminated by two 100-watt tungsten lamps. The space on the right is used as a "constant" electric sign in which 237 clear 5-watt tungsten lamps provide the necessary illumination.

The Patricia Lodge sign on Pender street west, is an excellent example of a type well suited to the requirements of private hotels and similar establishments. In a sign of this class the use of leaded glass provides plenty of scope for working out a variety of attractive designs in a wide range of color. The Bijou Theatre sign on Carrall street, near Hastings, is a neat type illustrating how electric signs may be designed to meet special demands. Particular care has been taken to emphasize the advertising point in this sign, the low admission price being prominently displayed. The sign is small compared to many in the vicinity, but owing to the fact that it is attached to the theatre at a good height above the street near a busy corner, it claims universal attention. The Hotel Ansonia sign placed at the corner of Dunsmuir and Howe streets illustrates the possibilities of the "T" sign, a type which, to judge from the large number in use throughout the city, has become popular in Vancouver. This sign is of the "constant" type, and measures 17 feet in height and 8 feet wide at the top. It is fitted with 180 tungsten lamps.

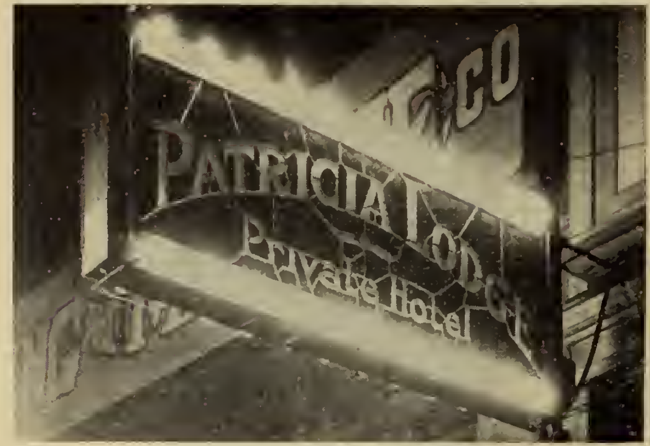


Fig. 5. Artistic sign in leaded glass

The different classes of electric signs dealt with in this article comprise a few of those which have been erected by Abbott & Castleton, a well-known Vancouver firm of sign specialists. This firm not only attend to the building of the signs and the preparation of the equipment for operation, but also undertake their maintenance after being erected. It is worthy of mention that the latter practice is one that has not been associated with the work of the various large sign companies hailing from the United States which handle contracts for national advertising projects in Vancouver. In the manufacture of signs only the best material should be employed. Piping should never be used as the frame work for roof signs as it is liable to break at the joints, which are the weakest points. A member of the local firm mentioned above stated recently that they invariably use angle steel for roof construction, the size of the steel being in proportion to the dimensions of each individual sign.

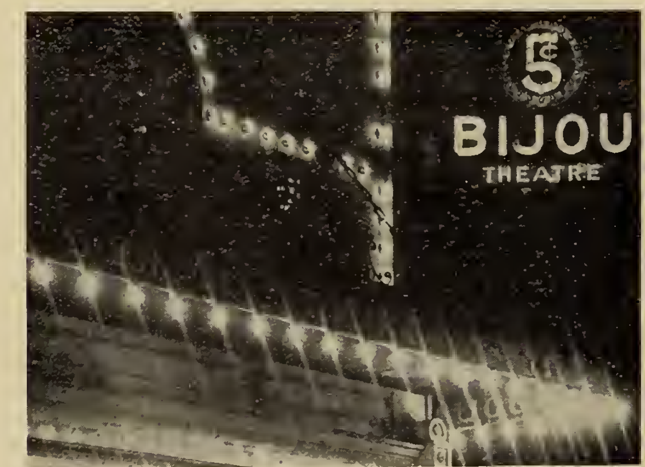


Fig. 6. Emphasis on low price

With the exercise of care in the selection of materials proper methods of construction and constant inspection after erection, a sign may be guaranteed for two years. In Vancouver only 5-watt tungsten sign lamps are in use at the present time, but it is considered advisable on the score of economy and greater efficiency that 10-watt lamps should be substituted if possible.

Two kinds of color caps are being used on signs in the city, viz., "A" and "B" caps. The "A" type is a semi-cap, which covers the lower part of the bulb, and should be used only for roof signs. The "B" type is a whole cap covering the entire top of the bulb and is particularly suitable for street signs. Special rates for sign lighting in Vancouver are given by the B. C. Electric Railway Company in order to encourage the industry.

The Electric Vehicle Association

The Electric Vehicle Association of America have long since demonstrated their usefulness in the promotion of the use of electric motor cars and trucks. So rapid has been the expansion of the association's efforts and influences, and so voluminous has the development work become that the officers have for a long time found it extremely difficult to, at the same time. administer to the affairs of the association and do justice to their personal business. As a matter of fact, some of the officers have sacrificed their own private matters in the interests of the association. It has now been decided to establish the office of permanent executive secretary and inaugurate a system which will permit the centering and rapid dispatch of the association's work.

The association feel that they have been fortunate in securing the services of A. Jackson Marshall as their executive secretary, as Mr. Marshall is by nature and training, also inclination, admirably qualified to properly discharge the important duties of this office. Mr. Marshall has, until somewhat recently, been identified with the lighting world, having been one of the most progressive, energetic and successful exponents of "better lighting." Indeed, to him is attributed much that has become modern practice in the art and science of lighting. He is credited with originating much of the effective publicity which brought the subject of lighting to the attention of the layman as well as those actively associated with the industry.

Mr. Marshall is one of the best known personalities in the central station field, he having actively co-operated with most of the public utilities in the country. It is felt that his knowledge of central station conditions; his well-known respect for broad, consistent development and equitable relationships, and his original and interesting method of obtaining results will cause him to early prove a factor in the further success of the Electric Vehicle Association. During the last several months Mr. Marshall has been associated with the General Motors Truck Company, having been in charge of this company's business in Northern New Jersey.

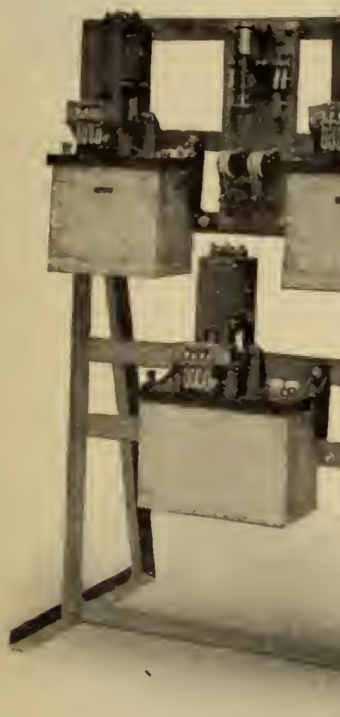
The new permanent head-quarters of the Electric Vehicle Association of America are now located at the United Engineering Society's Building, 29 West 39th Street, New York City.

The different large jobbers all over the country are sending out color mailing folders descriptive of the new "Oshkosh Guy Anchor."

New Automatic Controller for High Voltage Squirrel-Cage Motors

For centrifugal pumps and similar machines squirrel-cage motors connected directly to 1100 and 2200 volt three-phase systems are used to a considerable extent. The use of motors operating at line distributing voltages is frequently desirable for a number of reasons and for the automatic starting of these high tension motors a new line of self-starters has been designed by The Cutler-Hammer Manufacturing Company of Milwaukee. These controllers are of the multiple solenoid type consisting of an angle iron, floor type, self-supporting frame, which carries the high tension, oil-immersed, solenoid switches and necessary relays controlling the motor and auto-transformer circuits.

The oil-immersed type primary and starting switches used are operated by single-phase solenoids. All contacts are entirely enclosed under oil so that no live parts carrying 1100 or 2200 volts are exposed. Low voltage current is used for the operation of the solenoid coils. The capacities of the standard types of these self starters range from 20 h.p. to 300 h.p., and are made for both 25 and 60-cycle, three-phase circuits. They can be automatically controlled when operating on an open tank system by means of a float switch and on a closed or compression tank system, by means of a gauge or diaphragm pressure regulator. For remote control from one or more points control stations can be employed so that the operator need only push the button to start or stop the motor.

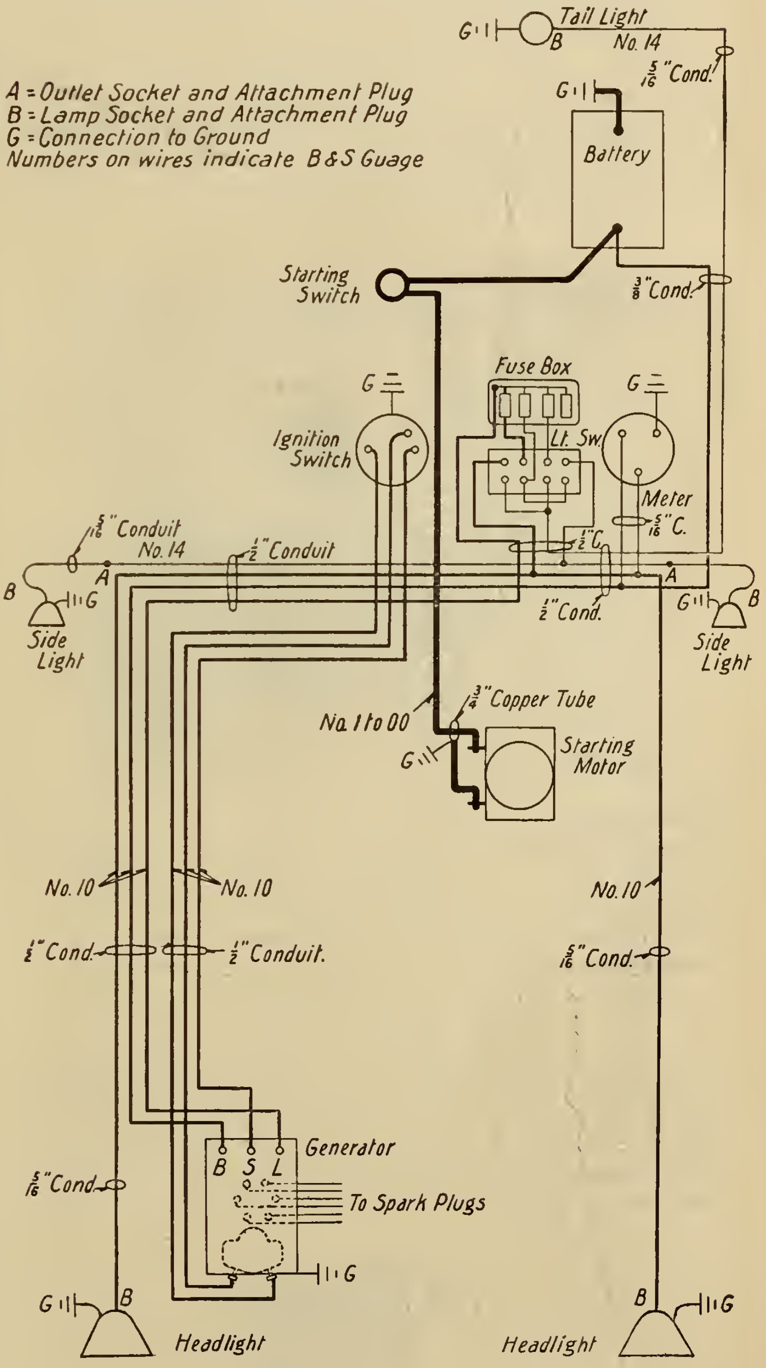


The "S & C" extra high potential fuses are now being made in Canada by the Economy Fuse and Manufacturing Company of Canada, Limited, Montreal, under license from Schweitzer and Conrad, Chicago. Indoor and weatherproof types, with mountings for all conditions of installations, are made up to 110,000 volts.

Advise our Subscription Department if your Electrical News does not reach you promptly.

Electric Equipment in Automobiles

A complete system of electrical equipment for automobiles is now being placed on the market by the Westinghouse Electric & Mfg. Company, the general design of which is shown in the accompanying line drawing. The lighting system alone consists of a generator and lighting switch for use in connection with a three cell, six volt storage battery.

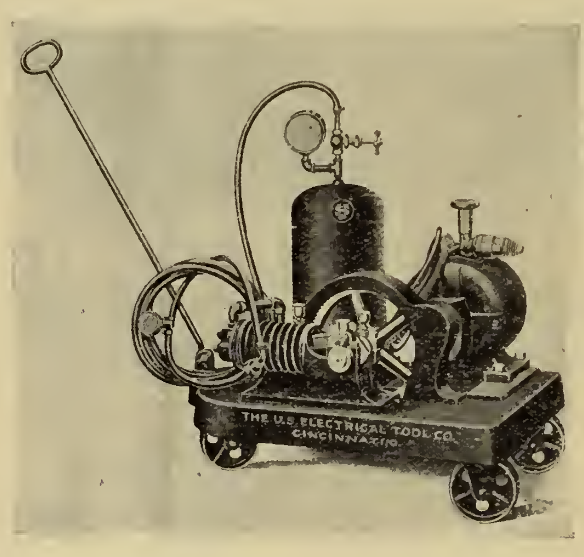


The ignition and lighting system consists in addition, only, of an ignition coil, a timer and a distributor as additional parts of the generator, with an ignition switch on the dash. The starting system consists of a six volt motor and a starting switch. Simplicity of wiring has resulted from having few parts to the equipment and from the use of the single-wire ground-return system.

The system as installed by this company is regenerative; that is, when the engine is not operating or when it is running at very low speed, power for the spark, the line and the starting motor is furnished by a battery, and this power is returned to the battery when the car is running at the usual speeds during the day and at higher speeds during the night. For such combined ignition and lighting it is essential that the instrument be such that a car can be operated on continuous night trips without exhausting the battery and on continuous day trips without injuriously overcharging it. In this system the generator has an output sufficient to carry an ample lighting equipment without drawing on the battery for power, and the design is such that at no time is the battery charged at an excessive rate.

A New Tire Pump

The illustration shows a new tire pump, suitable for public and private garages, which is sold by the U. S. Electrical Tool Company, Cincinnati, Ohio. It is simple and compact in construction, and being mounted on a truck it can be easily taken around the garage or outside to the curb. A tank 12 inches long by 6 inches diameter, into which the pump discharges, prevents condensation and oil from entering and injuring the tire. The pumping action is rapid, since a 35 x 4-inch tire can be pumped from flat to 70 lbs. in 1½ minutes. The motor is of Westinghouse make, ¼ horse-power in capacity, and can be operated from the lighting circuit.



A Useful Door Switch

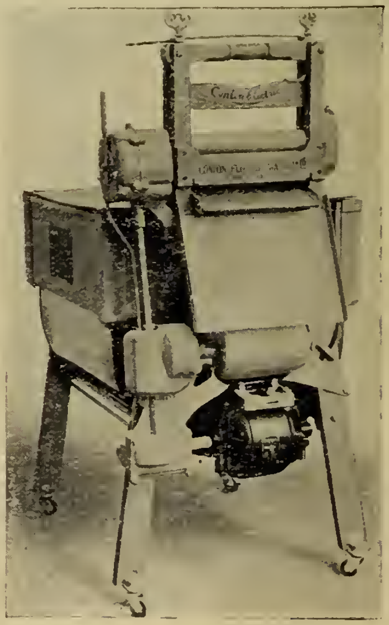
The cut herewith represents a useful type of switch manufactured by the Hart & Hegeman Manufacturing Company, through their Canadian agents the Canadian General Electric Company. The cut shown illustrates a switch that will operate either to close a circuit when the door closes and vice versa or to open the circuit when the door closes and vice versa, the position of the contacts being reversible. Special claim is made for the durability of this unit and for the valuable feature that no matter whether the door swells or shrinks the switch is always operative.

Electric Lamps Under Water

The illustrations herewith represent a new type of condulet known as the SP series, manufactured by the Crouse-Hinds Company of Canada. These are for use under water and take regular tungsten lamps up to 100 watt size or any lamp not exceeding 5½ x 8 in. in size. These condulets are designed to be set in the concrete at the bottom or sides of swimming pools, fountains, etc., and provide watertight housings for lamps. The inner surfaces are white enameled, to reflect the light through a heavy plate glass disk in the top of the condulet. This glass disk is suitably secured in a heavy brass ring that engages a female thread on the body of the condulet. The ring can be removed at any time when not submerged, thus providing for lamp renewal. All joints are sealed with thick rubber gaskets of best quality.

A New Electric Washing Machine

One of the conspicuous features of the Electric Washer illustrated herewith is its complete safety. Every moving part is enclosed so that it is impossible to catch the fingers or the dress. The tension on the wringer rolls can be instantly removed by a patented release, thus preventing injury from this source to the operator or to the clothes. A friction clutch protects the motor in case of an overload. No belts or chains are used, the motor driving through a steel worm and bronze worm gear which runs in hard grease; quiet operation is thus obtained. The motor and the drive are so located that they are out of the way and the whole machine is made neat and compact. The machine is lined throughout with metal, making it highly sanitary since there are no cracks and crevices to absorb dirty, soapy water. The



machine is made in three sizes, driven respectively by 1/6th, 1/5th, and ¼ h.p. Westinghouse electric motors which can wash and wring at the same time. It is manufactured by the Conlon Electric Washer Company, 312-320 North May street, Chicago, Ill.

Will hold Municipal Convention

A meeting of the executive committee of the Ontario Municipal Electric Association was held in Toronto on Wednesday, the 18th inst., at which it was decided to arrange for a convention at which matters of technical and general interest will be discussed. A committee consisting of Messrs. H. H. Couzens, Toronto; E. I. Sifton, Hamilton; H. J. Glaubitz, London; P. D. Yates, St. Catharines; and E. M. Ashworth, secretary-treasurer of the Association, have the matter in hand.

A Large Order

The Herbert Morris Crane & Hoist Company, Toronto, announce that their English company have just received an order from the London & North Western Railway Company for ten 10-ton hand overhead travelling cranes and two electric cranes. This is in addition to a previous order for eight 12-ton hand cranes from the same company making this one of the largest orders on record.

A Small Capacity Blower

The cut herewith represents a Hamilton Beach motor direct connected to a centrifugal blower or exhaust fan. This exhaust fan gives a pressure of from 1¼ to 1½ inches on a water column and delivers about 165 cu. ft. of air per minute. The speed of the motor is variable. It is series wound and universal on all currents of 110 volts. It is claimed to be an excellent machine to run forges, office ventilators, telephone booth ventilators, or indeed anything to be used in a place where a blower or exhaust fan of small capacity is required. Handled in Canada by R. E. T. Pringle.

Personal

Mr. P. D. Yates has been appointed manager and engineer of the St. Catharines Hydro-electric Commission.

Mr. L. Johnson, representing the Pulsometer Engineering Company, Limited, London, Eng., is making a business tour of Canada.

Mr. J. Antonisen, superintendent of the Brandon municipal street railway system, has resigned. He is being succeeded by Mr. Bowden.

Mr. W. P. Roper, formerly of Roper, Clarke & Company, has opened offices at 401 Lake of the Woods Building, Montreal, having been appointed eastern manager of the Canada Wire and Cable Company, Toronto, and district manager of the Canadian Moloney Electric Company, Windsor.

New Companies

Abitibi Power & Paper Company; capital $7,000,000, head office Montreal.

La Compagnie Electrique des Rivieries, capital $40,000, head office Notre Dame de Stanbridge, Que.

The General Electric Contracting Company has been incorporated with capital $10,000 and head office Vancouver.

The Interurban Company, Limited, has been granted a Dominion charter; capital $5,000,000; head office Toronto.

Trade Publications

Guy Anchor—A booklet descriptive of their new guy anchor being distributed by the Oshkosh Manufacturing Co.

Electric Fans.—Bulletin No. A4197, issued by the Canadian General Electric Company, describing and illustrating very completely the construction of their electric fans for 1914.

Graphic Meters—A booklet issued by the Esterline Company, Indianapolis, describing various types of graphic meters. The Esterline meter is a combination indicating and curve drawing instrument.

Moulded Insulation—A booklet issued by the Stevenson Company, Pittsburgh, Pa., describing the Stevenson moulded insulation and other moulded parts made from a number of different moulding mixtures, and claimed to be applicable to a wide range of uses.

Dumore—A folder published by the Wisconsin Electric Company, Racine, Wis., through their Canadian agents, R. E. T. Pringle, describing the Dumore suction cleaner—a small hand machine particularly valuable for the cleansing of upholstered furniture, clothing, etc.

Bell Transformers.—Pamphlet issued by Irving-Smith, Electrical Apparatus & Specialties, Montreal, describing two types of bell ringing transformers—Model B, suitable for moderately heavy work, delivering 7, 14 and 21 volts; Model C, a low capacity unit suitable for private residences.

Sight Flow Indicator.—Bulletin No. 57, issued by the Richardson-Phenix Company, Milwaukee, describing the Phenix sight flow indicator—a device for inserting in pipe lines which shows at a glance, or indicates electrically, whether or not the liquid is flowing. It is used in water lines of o.i.w.c. transformers, in the supply pipes and water jackets of gas engines, in circulating oil systems, etc.

Canadian Westinghouse—have recently distributed the following publications:—Circular 1104-9-13 describing the Westinghouse portable meter for alternating and direct current; circular No. 1165 describing Westinghouse electric fans, 1914 type; pamphlets descriptive of the following interesting subjects:—the electric breakfast set, the electric curling iron, the ozonizer sales helps, the latter for the use of dealers and their salesmen.

Door Safety Switches—An 8-page pamphlet on door safety switches for use with electric elevators has just been published by The Cutler-Hammer Manufacturing Company, of Milwaukee. A great majority of accidents on all types of elevators are the result of setting the elevator machine in motion before the doors are closed and locked and the passengers clear. With the ever-increasing number of passengers this safety feature is of utmost importance.

Current News and Notes

Bassano, Alta.

Tenders received for the construction of a telephone system in this town were not considered satisfactory and new tenders will be called later.

Berlin, Ont.

The gross receipts of the electric and power departments for the past year were $94,555 and net $14,384. Five per cent. has been allowed for depreciation. The street railway shows a net profit of $4,160. This is divided between Berlin and Waterloo in the proportion of three to one.

Brandon, Man.

The Brandon municipal electric railway system, as the result of a deficit in the neighborhood of $100 per day has found it necessary to take immediate steps to curtail the expenditures in connection with the operation of their road. As a result a large number of employees will be dispensed with, and the cars will be operated as one-man cars. It is also understood the schedule will be somewhat reduced and there will be no line extensions in the near future. It is hoped in this way to overtake the deficit account which has been piling up at an alarming rate. Following the resignation of Superintendent Antonisen, Mr. Bowden has been placed in charge of the much curtailed operations of the Brandon system.

Brantford, Ont.

After a keen competition, the contract for lighting the Congregational Church, Brantford, was awarded to the Western Counties Electric Company, at a rate of 2½c per kw.h.

The power customers of the Western Counties Electric Company have been notified that their lighting rates in future will be made the same as their power rates, namely, 3c per kw.h., with discounts.

Burford, Ont.

A by-law will be submitted to the ratepayers on March 9th to authorize the village council to make a contract with the Hydro-electric Power Commission of Ontario.

Burks Falls, Ont.

The Hydro-electric Power Commission of Ontario have been requested to investigate the possibility of power on the Magnetawan River to supply the Parry Sound district, and engineers will be sent to investigate the matter.

Calgary, Alta.

Tenders are received up to March 18 for two 12,000 volt, 3,000 kw. transformers for the city electric department.

A by-law will be submitted authorizing the expenditure of $300,000 for electric extensions of various sorts.

The gross earnings of the Calgary Power Company during last year were $240,116, an increase of $47,770, while the net increased $26,353, the surplus, after interest charges, being $88,026. Mr. E. B. Bennett, the president, in his report states: "The fourth unit at Horse Shoe Falls plant was installed during the year, bringing the equipment at that point up to its ultimate capacity. An entirely new development was constructed by the company's force during 1913 at the Kananaskis Falls, a distance of two miles above the Horse Shoe Falls development, and the first 6,000 h.p. unit was put into service on December 27th. Another 6,000 h.p. unit is now being installed, thus completing all construction work at present in hand. There are now duplicate transmission lines to Calgary, and a third to Exshaw was installed during the year for the purpose of avoiding any possible transmission trouble. Among other contracts the company has one with the city of Calgary, providing for a supply of a minimum of 5,000 h.p. to be used by the city for the operation of its municipally-owned street railway, electric lighting and power departments.

Cape Breton, N.S.

The gross earnings of the Cape Breton Electric Company for the year ending December 31, 1913, show an increase of $20,775 in gross and $5,702 in net for the past year.

Chatham, Ont.

An electric railway line connecting Thamesville and Sombra is reported to be in prospect. Mr. T. M. Little, one of those interested, is said to have stated that work will be commenced early in the spring.

Clinton, Ont.

The town of Clinton was lighted for the first time by Niagara Falls power on the evening of February 15.

Cobalt, Ont.

The installation of electrical machinery at Fountain Falls, Montreal River, being undertaken by the Northern Ontario Light & Power Company is held up temporarily pending the arrival of the generators. The turbines are now being placed in position.

Elk Lake, Ont.

Mr. A. J. Reece, owner of the Elk Lake telephone and telegraph line, has sold out to the T. & N. O. Railway Commission.

Fort William, Ont.

The programme in connection with the street railway system for the year 1914 includes an auxiliary line right across the city. Sufficient money has been voted for this work.

Galt, Ont.

A radial railway line from Galt to Hamilton has been proposed; information will be obtained as to the probable cost and earnings of the road and an effort will be made to interest the municipalities along the line.

Halifax, N.S.

At the last session of the Nova Scotia legislature an act was passed providing for the appointment of a commission to inquire into the application of electricity in the coal mines of the province. The personnel of the committee which was recently appointed is as follows:—Judge Patterson, New Glasgow, chairman; T. J. Brown, Superintendent, Nova Scotia Steel & Coal Co.; V. McFadden, chief electrician of the Dominion Coal Co.; John Moffat, Glace Bay; and Henry Perrin, Spring Hill. The commission have already paid a visit to the coal fields of the Maritime Coal, Railway & Power Company, Joggins Mines, as being the best electrically equipped mine in the province. Several mine centers will be visited in the near future and it is understood the commission will make a report in the early summer.

The gross earnings of the Halifax Electric Tramway Company for the year 1913 were $605,933, as against $539,953 in 1912. Net for the past year was $337,008, an increase of $50,448 over the previous year. The receipts of the Electric Light & Power Department were $242,085, as against

$225,654 a year ago. Mr. E. A. Robert, Montreal, is president of the company, and Mr. O. E. Smith, Halifax, vice-president.

Hamilton, Ont.

The report of the Dominion Power & Transmission Company for the year 1913 as presented by J. R. Moodie, president, at the annual meeting, shows gross earnings for the year as $2,737,806, an increase of $174,435. The considerable sum of $442,677 was set aside for renewals and maintenance, of which $337,270 was actually expended, the balance being placed to the credit of this account. The report speaks also of work at present under way in connection with their immense steam plant and in railway line and rolling stock extensions. At the annual meeting it was also stated that the company had in mind the construction of a branch line off the Brantford and Hamilton section at a point near Langford to Galt which would effect a comparatively direct road between Galt and the city of Hamilton.

The installation of two 4,000,000 gallon pumps has been recommended by the city engineer and will be passed upon by council.

A steam auxiliary plant in connection with the waterworks system is under consideration by the Board of Control.

Havelock, Ont.

The town council have requested the Hydro-electric Power Commission of Ontario to submit estimates regarding the supply of light and power.

Huntsville, Ont.

Negotiations are proceeding between the Huntsville council and the Bracebridge electric light commission regarding a supply of electricity in Huntsville from the Bracebridge plants.

Kamloops, B.C.

Mr. T. R. Cornick, contracting engineer, Vancouver, was recently awarded an important contract covering the erection of 43 miles of wooden pole transmission line for the city of Kamloops between the city's hydro-electric generating station on Barriere River and the sub-station in Kamloops. The contract calls for the use of 45-foot wooden poles with steel core aluminium conductors, equivalent to No. 4, B & S. gauge solid copper. Spans will average 200 feet. This will be a 45,000 volt line using pin type insulators manufactured by the Locke Insulator Company. The line will carry a ground wire at the peak, and one metallic telephone circuit. Du Cane, Dutcher & Company, Vancouver, are the consulting engineers for the city of Kamloops in connection with the extensive scheme of hydro-electric development, of which this work will form a part.

Kalso, B.C.

This city is negotiating for the purchase of the distribution plant of the Kootenay Electric Company, Limited.

Listowel, Ont.

At a meeting of representatives from the counties of Bruce, Grey, Perth, Wellington, and Huron held recently at Listowel, the delegates formed themselves into the Northwestern Ontario Hydro Association, for the purpose of undertaking negotiations with the Ontario Hydro-electric Power Commission regarding the supply and distribution of electric power in their district.

Marmora, Ont.

The North Mutual Rural Telephone Company has been organized here with 22 shareholders and it is expected about ten miles of line will be put in during the present summer. Chas. Jones is the secretary-treasurer.

Moncton, N.B.

The city council have authorized the preparation of plans and specifications for a new system of street lighting.

Montreal, Que.

Plans have been prepared by the Electrical Service Commission, Montreal, for laying additional conduits, for which tenders will be called early in the spring. Four separate plans are being drawn up dealing with conduits for the business section, these including the intersecting streets as well as the main thoroughfares. The chief streets on which the conduits are to be built are: St. Lawrence Boulevard, from Sherbrooke street to the river front; Craig street, from McGill street to St. Lawrence Boulevard; portions of Fortification Lane, St. James street, Notre Dame street, and both sides of Victoria Square. A special conduit for the Montreal Tramways Company will be constructed from the company's power house, William street to McGill street, where it will link up with the general scheme. Preparations are being made for the wires being drawn in the conduits already constructed; this will take a considerable time, as in certain instances work can only be done at nights and on Sundays.

At a recent meeting of the directors of the Canadian British Insulated Company, Limited, Montreal, Mr. Cyril G. Savage was appointed secretary-treasurer in succession to Mr. H. Brown, resigned.

The Montreal Tramways Company have put several trailers (a description of which has appeared in the Electrical News) on the St. Catherine Street route. Mr. J. E. Hutcheson, the manager of the company, has expressed the opinion that, as the result of the short experience, the cars will contribute to eliminate the crowded conditions which have hitherto existed. The trailer is boarded from the front, the end portion being entirely utilized for seating accommodation.

The Northern Electric Company, Limited, recently incorporated with a capital of $10,000,000, will absorb the Northern Electric and Manufacturing Company, Limited, and the Imperial Wire and Cable Company, Limited, Montreal. Both the latter companies have been in working alliance, and they will now be merged under the new name, the present names of the two concerns being dropped when the new company comes into working order. As we have already mentioned, the Imperial Wire and Cable Company are now building a very extensive new plant in Montreal, which will largely increase their present capacity.

Moose Jaw, Sask.

The issue of $50,000 new stock made by the Moose Jaw Street Railway Company was eagerly subscribed by the present shareholders, who are greatly pleased with the efficient management of the concern.

Ottawa

A company called the Niagara-Welland Power Company is seeking the consent of parliament to develop and sell power that will be made available by the construction of the new Welland Canal. The matter will be submitted to the Ontario Hydro-electric Commission before any definite steps are taken.

Plattsville, Ont.

A by-law recently passed authorizing the council to close a contract with the Hydro-electric Power Commission of Ontario for a supply of electric energy.

Port Arthur, Ont.

The Bergman Electric Company is opening a new electric supply store here about the 1st of March.

The net earnings of the Port Arthur end of the electric railway line, for the month of January, were $10,129, as compared with Fort William's earnings of $11,004.

Preston, Ont.

Alterations and extensions to the electric lighting system are contemplated.

Regina, Sask.

The operating returns of the municipal street railway system for the week ending January 31 are as follows:—revenue, $4,293.85; passengers carried, 100,987; passengers carried including transfers, 112,213. For the week ending February 7 corresponding figures are $4,536.20; 107,353 and 119,982; and for week ending February 14 $4,110.50, 100,828, 112,787.

Railway extensions to the amount of approximately six miles, rolling stock to include four double truck cars and a certain amount of feeder lines have been approved by the city council.

Reserve Jct., N.S.

The new turbo-egenerator of the Cape Breton Electric Company has been placed in operation at this point.

Saskatoon, Sask.

The city council at a recent meeting decided to extend their street car line though the 19th street subway.

The city council has entered into an agreement to supply power to the Northland Milling Company, located at Factoria, on the northern outskirts of this city. The price will be two cents per kw. hour. An overhead line will be constructed from the city power house at Factoria. The city will bear the expense of the line from the power house to the city limits, and the milling company will there take over the line and construct it the remainder of the way. The company's plant is now ready to operate and has a capacity of 700 barrels per day, capable of enlargement to 1,500 barrels. This is the second large United States milling concern to establish here within the past two years, the other being the sole western plant of the Quaker Oats Company.

The receipts of the municipally owned and operated electric street railway system continue to encourage. For last month a total of 320,661 passengers were carried, which with the total receipts shows an increase in traffic of six and a quarter per cent. The total mileage of the month was 62,370 miles. The average amount paid by each passenger was 4.447 cents. On the Sutherland line the average passenger paid the amount of 9.294 and a total of 15,231 people were carried on this line during the month. The fact that Saskatoon's population is about 30,000, and that more than that number used the cars every three days of the past month, is considered by the officials to be very satisfactory.

South Porcupine, Ont.

The Canadian Allis-Chalmers, Limited, have recently shipped for the Dome Lake Mining & Milling Comyany the following equipment:—Two 175 kv.a., oil filled, self-cooled transformers, 12,000/550 volts, 25 cycles; one 150 h.p. slip-ring, wound rotor type motor, 480 r.p.m., 550 volts, 25 cycles, 3-phase; one 52 h.p. slip-ring, variable speed, 720 r.p.m., 3-phase, 25 cycle, 550 volt hoist motor fitted with extended shaft for herringbone gear and out-bearing solenoid brake, reversible brake, etc.; one 12,000 volt aluminium lightning arrester; switchboard, circuit breaker, etc. The equipment will be installed by Mr. Geo. McDowell, electrician for the Hudson Bay Mines Company, Cobalt.

Strathroy, Ont.

The by-law carried by a considerable majority authorizing the council to close a contract with the Hydro-electric Power Commission of Ontario for a supply of light and power from Niagara Falls.

Thornhill, Ont.

A recommendation has been made by the property committee that an agreement be entered into with the Toronto & York Radial Railway Company to supply electric power and light to the industrial farm near Thornhill. The rate is understood to be 8c per kw.h. for the first 30 hours' use of installed capacity with a graded scale for consumption in excess of this amount.

Timmins, Ont.

The Northern Canada Power Company are installing an electric plant at Timmins, Ont.

Toronto, Ont.

Tenders are received for transformers up to March 12 by the Toronto Hydro-electric Power Commission.

An important meeting of the Hydro-electric Power Commission of Ontario was held on February 11 at which it was decided to proceed immediately with the construction of a duplicate high voltage line between Niagara Falls and Dundas. This will probably be the busiest season the Hydro Commission have yet experienced, work at present under way including the extension of the line from St. Thomas west to Windsor, the construction of a 46,000 volt line from Niagara Falls to Welland, particularly for power purposes, the development of Eugenia Falls and the distribution of this power, to say nothing of the possibilities of radial railway lines.

Following the failure of the Toronto Railway Company to remove snow from the streets as ordered by Commissioner of Works Harris, Corporation Counsel Geary has been requested to take action in the courts to compel the company to observe the order. The snow referred to is that thrown to the sides of the track by the company's snow sweepers.

The Board of Control have reached a decision to install steam equipment for operating the waterworks pumps and a scheme has been brought forward by which this can be made a part of a larger steam stand-by plant to act as a safeguard in case of trouble in the high tension transmission line.

Transcona, Man.

A by-law has been passed in the legislative railway committee granting power to Transcona to construct, maintain and operate a street railway in the town.

Vernon, B.C.

A by-law will probably be submitted in the near future calling for the expenditure of $11,000 on electric light extensions.

Waskada, Man.

The matter of a municipal electric plant to supply light to the residences and streets is under consideration.

Winnipeg, Man.

A contract has been awarded to the Canadian Allis-Chalmers, Limited, for head-gate and head-gate lifting mechanism, etc., for power plant extensions at Point du Bois.

Woodbridge, Ont.

The Hydro-electric Power Commission of Ontario have quoted the village of Woodbridge a price of $38.50 per h.p. and it is probable a vote will be taken in April.

New Books

Modern Seismology.—By G. W. Walker, F.R.S., being one of a series of monographs on physics edited by Sir J. J. Thompson, F.R.S., and published by Longmans, Green & Company, London. The publishers' agents for the Dominion of Canada and Newfoundland are the Renouf Publishing Company, 25 McGill College Avenue, Montreal, Que. The book is written from the point of view of seismology as a branch of physics and particularly as it is determined by observatory conditions. The author has had wide experience with the installation and operation of seismographs and his treatment of the subject is at the same time interesting and authoritative. The book is well illustrated; price $1.50 net.

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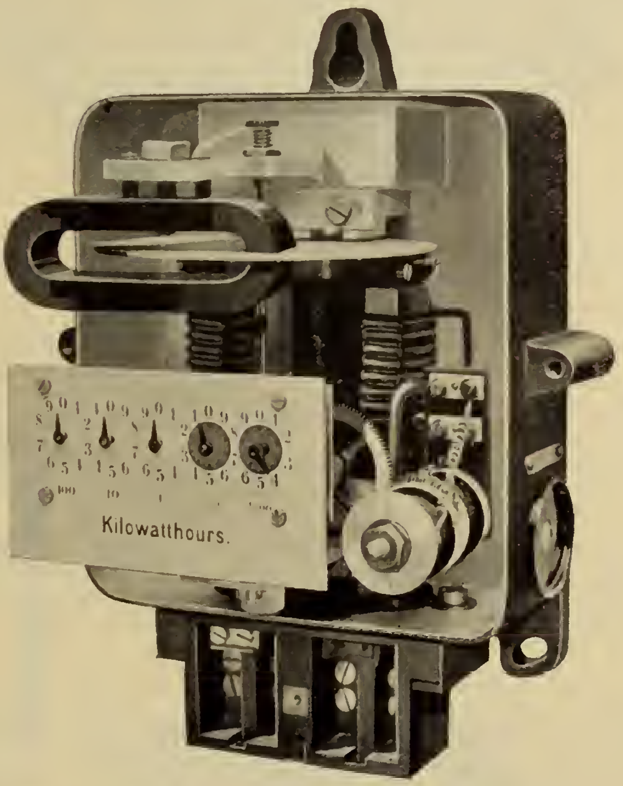

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Publisher's Notice

Advertisements under "Situation Wanted" "Situation Vacant" or Miscellaneous, are charged at 2 cents a word per insertion, minimum charge 50 cents.

Advertisements for tenders, equipment, wanted or for sale, etc., are charged at $2.10 per inch.

All advertisements must be in the publisher's hands by the 10th or 23rd of the month to insure insertion in the subsequent issue.

Town Engineer Wanted

Town of Melville, Saskatchewan

Applications will be received by the undersigned until six p.m., Monday, **March 16th, 1914**, for the position of engineer for the Town of Melville. Applicants will please give details of experience in sewage installation and other branches of work, and state salary required.

By order,
FRED. H. CLARKSON,
Town Clerk.

5-6

CITY OF REGINA

Sealed tenders, registered and clearly marked on the outside of the envelope, "Tender on Generating or Distributing Equipment for the Electrical Department," and addressed to the City Commissioners at Regina, Saskatchewan, will be received up until noon of March 28th, 1914, for the supply of:—

Generating Equipment

Item 1—Station switchboard consisting of two exciter panels, six generator panels, one totalling panel and sixteen feeder panels.
" 2—Six three phase, feeder regulators.
" 3—One motor-driven exciter, 125 kw.
" 4—One geared turbine-driven exciter, 125 kw., electrical end speed not over 900 r.p.m.

Distributing Equipment

Item 1—Weather-proof copper wire.
" 2—Insulators, top pins, etc.
" 3—Cross-arms.
" 4—Pole line hardware.
" 5—Cedar poles.
" 6—Pole type transformers.
" 7—Street lighting equipment.
" 8—Cut-out mast arms.
" 9—Integrating wattmeters.

Prices to be f.o.b. Regina.

Copy of specifications may be obtained from E. W. Bull, Superintendent of Light and Power, Regina, Sask.

A marked cheque for 5 per cent. of the amount of tender price to accompany tender.

The City Commissioners reserve the right to reject any or all tenders.

5-6 Superintendent of Light and Power Dept.

NOTICE

Application of the Michigan Northern Power Company to the International Joint Commission

Notice is hereby given that the application of the Michigan Northern Power Company to the International Joint Commission for approval of proposed lease with the United States, and of diversion of water, construction of compensating works, and plans therefor, in the St. Mary's River at Sault Ste. Marie, will be heard in the Federal Building in the City of Detroit on Monday, March 9th next, at ten o'clock a.m. All persons interested in this application are entitled to be heard with respect thereto before the Commission.

LAWRENCE J. BURPEE,
Ottawa, Canada.
WHITEHEAD KLUTTZ,
Washington, D.C.
Secretaries of the International Joint Commission.

5

SECOND HAND ELECTRICAL MACHINERY

Bought, sold, rented, and exchanged. We have the largest stock in America. Send for our monthly bargain sheet showing complete stock with our prices.

GREGORY ELECTRIC CO.
CHICAGO, ILLINOIS

Established 1893

CANADIAN OFFICE & SCHOOL FURNITURE CO. LIMITED
PRESTON ONT.
FINE BANK, OFFICE, COURT HOUSE & DRUG STORE FITTINGS.
OFFICE. SCHOOL. CHURCH & LODGE FURNITURE
SEND FOR CATALOGUE

JOH. WOLFF & CO.
GOUDA (HOLLAND)

Manufacturers and Exporters of Electric Lamps.

SPECIALTY—POCKET LAMPS

Electrical Machinery

Motors, Dynamos, Generators,
Electrical Pumps and Supplies.
Electrical Contractors.
Motor Repairs.

MAC ELECTRIC CO

52 Queen Street - OTTAWA

PROCURED IN ALL COUNTRIES
LONG EXPERIENCE IN PATENT LITIGATION
SEND FOR HAND BOOK

PATENTS

PHONE MAIN 2582

RIDOUT & MAYBEE

59 Yonge Street
TORONTO, - - - CANADA

We Have a Bell For Every Purpose

There can be only **one best** and that is the Schwarze. No. 12 Common Magneto Extension for telephone Service is illustrated herewith. The spools are large enough so that in no case is it necessary to use over No. 35 magnet wire, thereby obtaining the maximum number of ampere turns, and this wire is **all active**. Armature is under influence of coils its entire length. Poles arranged so that permanent magnet cannot be discharged, and will not weaken.

No. 13, same as No. 12, except larger and **very** much louder, and is for signalling purposes on high tension 60 cycle. Fully approved by Underwriters.

All weatherproof. Write for catalogue. **All resistances.**

Schwarze Electric Co., Adrian, Michigan

Norton Telephone Co., Canadian Agents

TEN POINTS of EXCELLENCE

1. The scale is uniform throughout the entire range of deflection.

2. The readings can be made with practically the same precision on violently fluctuating loads as on steady loads.

3. The indications are equally accurate on direct-current circuits or on alternating-current **circuits of** any frequency, power-factor or wave form within commercial limits. Therefore, these watt-meters can be calibrated with direct-current and used on alternating-current circuits without change of calibration.

4. The scale is flat and is therefore easily read.

5. The pointer is entirely free from vibration produced by mechanical resonance.

6. The power consumption is extremely small.

7. They have a large overload capacity, which will allow the measurement of full power at power-factors below 0.50.

8. They are far more reliable and durable than any commercial wattmeter heretofore built.

9. They are accurate within the limits of scale reading, regardless of changes in temperature, frequency, power-factor and wave form, within the range of commercial practice.

10. The zero position of the pointer can be adjusted from the outside without removing the instrument from the board.

In the **Weston Switchboard Wattmeter** every heretofore existing difficulty has been satisfactorily overcome by intelligent design and skillful construction and the results attained with these instruments are far in advance of anything ever accomplished in the art of commercial electrical measurement. Send for catalogue giving full information regarding **our complete** line of **A.C. Switchboard** Indicating Instruments, Voltmeters, Ammeters, Wattmeters, Synchroscopes, Power Factor Meters, Frequency Meters, also D.C. Instruments.

Weston Electrical Instrument Company,

Main Offices and Works
NEWARK, N. J.

New York, 114 Liberty St.
Chicago, 832 Monadnock Blk.
Boston, 176 Federal Street.
Philadelphia, 342 Mint Arcade.
Birmingham, American Trust Bldg.

St. Louis, 915 Olive Street.
Denver, 231 15th Street.
San Francisco, 682 Mission St.
Cleveland, 1729 E. 12th Street.
Detroit, 618 Union Trust Bldg.

Montreal
Winnipeg
Vancouver
Calgary
} Northern Electric & Mfg. Co.
Toronto, 76 Bay Street.

London, Audrey House, Ely Place, Holborn.
Paris, 12 Rue St. George.
Berlin, Genest St. 5, Schoenberg
Johannesburg, So. Africa, F.. Peabody Rice, Standard Bank Building, Harrison St.

Power Cables

Manufactured by

British Insulated & Helsby Cables, Limited

PAID-UP CAPITAL, $8,500,000.00

HEAD OFFICE—PRESCOT, ENG. Works at PRESCOT, HELSBY and LIVERPOOL

Illustration shows a No. 10 B & S, 3 conductor, paper insulated lead covered and double steel tape armored cable for a working pressure of 660 volts. This cable is for laying direct in the ground without any protection whatever and is similar to that supplied to the cities of Saskatoon, Prince Albert, etc., etc.

WRITE FOR ILLUSTRATED CATALOGUE

SOLE CANADIAN REPRESENTATIVES :

Canadian British Insulated Co. LIMITED

MONTREAL, QUE.

The

Lachute Shuttle Co.

Limited

Lachute Mills, Que.

Manufacturers of

CROSS ARMS made from straight grained Douglas Fir, Long Leaf Yellow Pine and Red or Norway Pine.

The largest manufacturer of Cross Arms in the East.

INSULATOR TOP PINS made from Birch, Elm, Locust and Oak.

BRACKETS made from Birch and Oak.

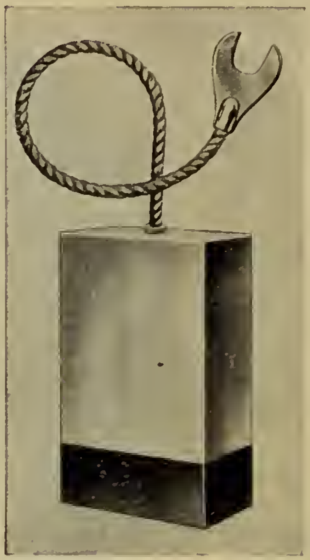
POLE STEPS made from Oak.

STRAIN PINS made from Second growth Hickory.

SPECIAL PINS for HIGH VOLTAGE TRANSMISSION made from Locust and Oak, all kinds and sizes.

All products boiled in Parafine and Stearine or Creosoted if wanted.

CORRESPONDENCE SOLICITED



CARBON BRUSHES

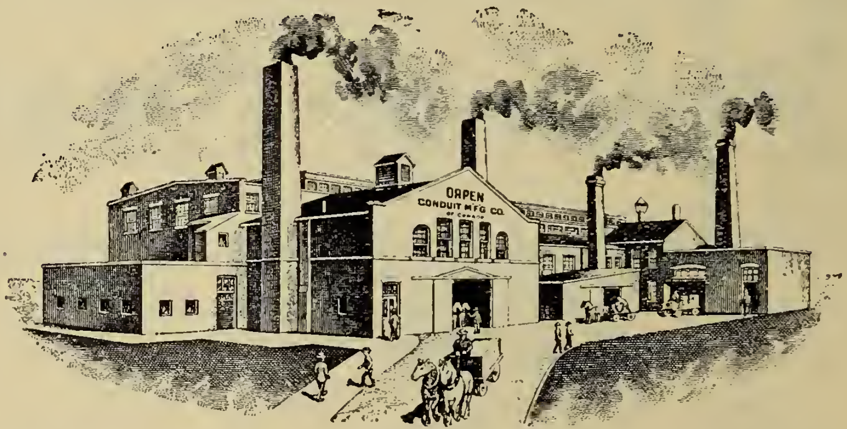
For over twenty years we have been marketing carbon brushes and are able to guarantee a perfect product. Becker brushes have great strength, perfect lubrication and will not split or break.

Send us your inquiries for any style of Gauze-Carbon or Magneto Brushes. Get our catalogue containing pri

Becker Brothers

561 W. Washington St., Chicago, Illinois

The home of
XCELADUCT
and
ORPENITE
CONDUITS


ORPEN CONDUIT MFG. CO. OF CANADA

Queen
and
Dufferin
Streets
TORONTO

"XCELADUCT"

INTERIOR

"Xceladuct" is a high grade of galvanized conduit made of easy-bending spellarized steel tubing, doubly protected against rust by copper plating and zinc coating. Every length is made up with clean threads and smooth enameled interior, allowing easy and rapid fishing.

MANUFACTURERS OF
XCELADUCT
AND
ORPENITE
CONDUITS

HEAD OFFICE

Let us send
Prices and Samples

"ORPENITE CONDUITS"

CONDUITS

"Orpenite" Enameled Conduit is made of easy-bending spellarized steel tubing which is protected against rust and proof against all temperature conditions by coatings of specially prepared enamel. Each length presents clean threads and a smooth interior permitting of easy and rapid fishing.

THE ORPEN CONDUIT MANUFACTURING COMPANY of CANADA

TORONTO MONTREAL

Superior

Pole Line Material

We can furnish any quality of arms, pins, brackets, or pole line hardware you call for if you can wait for factory shipment, but stock only which carries our guarantee.

Superior

This includes: Washington Fir not less than 85% heart, Georgia Pine—Long Leaf—not less than 75% heart Kyanized—Spruce. Pins and Line Hardware—A T and T specifications.

STUART-HOWLAND COMPANY

131 to 141 Federal St., - BOSTON

The

Canadian Turbine Water Wheel

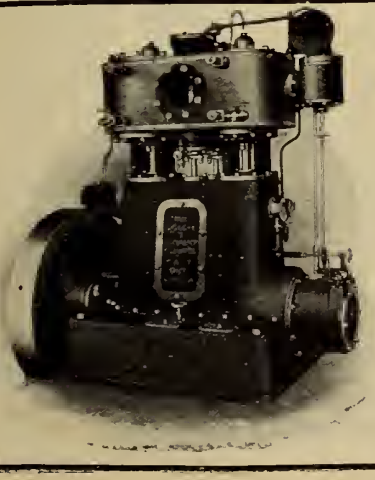
A normal speed Turbine of Normal Capacity. Not overgated or over-rated. Steady, Sturdy Power from Quarter to Full Gate.

Efficiency, Durability and Genuine Satisfaction assured.

Write for Catalogue No. 12

CHAS. BARBER & SONS, Meaford, Ontario

Established 1867



Vertical, Forced Lubrication

Quick Revolution Engines

With Combined Throttle and Expansion Governor

These engines are giving excellent service wherever installed. They are built for service and are economical in consumption of steam and require little or no attention while running. The materials used are in accordance with British Admiralty Specifications. Ask for detailed information.

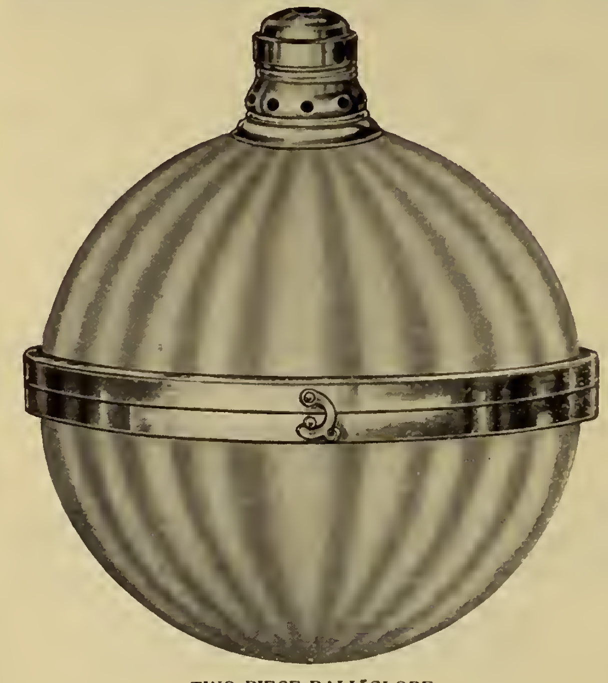
All Engines are Tested under Steam before leaving our works

THE GOLDIE & McCULLOCH COMPANY, LIMITED

Head Office and Works: Galt, Ontario, Canada

Branches:—Toronto Montreal Winnipeg Vancouver and St. John, N. B.

MOONSTONE SANITARY LIGHTING GLASS



TWO PIECE BALL GLOBE
4065—10" diameter 4066—12" diameter 4067—14" diameter

Cleanliness of your lighting units is essential to maintain their original efficiency.

Our new **sanitary** type reflectors and globes have no crevices to harbour unsightly dust collections.

Simplicity of design renders the glass easily cleaned without being removed from the fixture.

This means a **saving.** Write for particulars.

DISTRIBUTING REFLECTORS
4051— 40 watt 4053— 60 watt
4057—100 watt 4059—150 watt

DIFFUSING REFLECTORS
4050— 25 watt 4052— 40 watt 4054— 60 watt
4056—100 watt 4058—150 watt 4060—250 watt

Jefferson Glass Co., Limited, Toronto, Ont.

BRITISH MADE
STERLING
TELEPHONES

2-Shot Blasting Machine

2-Shot Blasting Machine

No. C2598 Blasting Machine for Tree Stumping, etc.

Other sizes firing up to 70 Shots.

MANITOBA.—The Can.-Brit. Engineering Co., Ltd., 324 Smith Street, Winnipeg.

ONTARIO.—Chapman & Walker, Ltd. 116-118 Richmond St. W., Toronto.

SASKATCHEWAN.—The North-western Electric Ltd., Scarth Street, Regina.

BRITISH COLUMBIA.—Cope & Son, Ltd., Water Street, Vancouver.

ALBERTA. — General Supplies, Ltd., 122 Eleventh Ave. W., Calgary.

QUEBEC.—Stocks kept by: Dawson & Co., Ltd., Montreal. Mechanics Supply Co., St. Paul, Que.

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NEW BRUNSWICK.—Stocks kept by: St. John Railway, Dock St.

Cedar

We are now handling both Western Red Cedar and Northern White Cedar Poles. Write for prices. Quick shipments.

Crawford Cedar Co.
Menominee, Mich.

Poles

Our
British Columbia Cedar Poles

will meet your most exacting requirements. You'll find them straight, strong, sound-butted, and shipped on time. Let us quote you.

The Lindsley Brothers Company
"Good Poles Quick"
Spokane — Chicago

Construction Supply Co., Toronto, Representatives
Frank E. Filer—Winnipeg

Pole Line Hardware

That Stands the Test of Time and Weather

WE MAKE ALL ARTICLES REQUIRED

WIRES
Copper—Galvanized
For
Electrical
Construction
Work, etc.

Send us your specifications to quote on.

All Styles of:
Bolts, Nuts,
Rivets,
Washers and
Screws.
Pole Steps,
Guy Clamps
Cross Arm Braces

Lowest Prices—
Prompt Shipment.

The
Steel Company of Canada
Limited

Hamilton, Montreal, Toronto, Winnipeg
Vancouver, Victoria, St. John, N.B., Halifax

Tenders Wanted

should be advertised for in the "Tenders and For Sale Department" of the CONTRACT RECORD AND ENGINEERING REVIEW. This paper is the "Tender Ad." medium of Canada and always brings bids from the reliable contractors and supply houses.

File your plans for any work on which you are inviting bids, in our offices at Toronto, Montreal, Winnipeg or Vancouver.

Contract Record
and Engineering Review
Toronto Ontario

WESTERN LUMBER AND POLE CO
POLES POSTS TIES

7 CEDAR POLE YARDS IN B. C.—7
For prices on B. C. Cedar Poles address
WESTERN LUMBER & POLE COMPANY
Main Office - DENVER, COLO.

NAUGLE Pole & Tie Co.
Main Office
5 South Wabash Ave.
Chicago, Illinois

We have yards in Canada guaranteeing our motto:
"SERVICE"
"PRICE" "QUALITY"
ONE QUALITY
ANY QUANTITY

POLES

Testing

Magnetos

10,000 to 100,000
Ohms.

"Built to stand the
hard knocks."

When you buy a Testing Magneto
SPECIFY A

"Holtzer-Cabot"

The name stands for excellence in every detail.

Send for Booklet No. 153 N

The Holtzer-Cabot Electric Co.
CHICAGO, ILL. BROOKLINE, MASS.

Get the Agency NOW for

"CONDOR" LAMPS

They are proving to be the best sellers on the Canadian market.

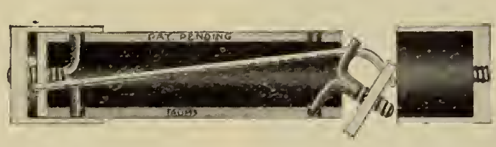
See next issue regarding our

New "Condor" Lamp
(Canadian Patent applied for)

Sole Canadian Distributors

C. H. BASTERS & COMPANY
TORONTO 22 College Street ONTARIO

DAUM REFILLABLE FUSES



Refilled by simply bending the fuse over the metal cross piece and screwing the cap in place.

No threads on the fibre tube to strip off or screws, rivets or clamps to get loose. Merely two holes in the fibre tube and held in place by the cap. This metal to metal contact is not affected by the swelling or shrinking of the fibre shell.

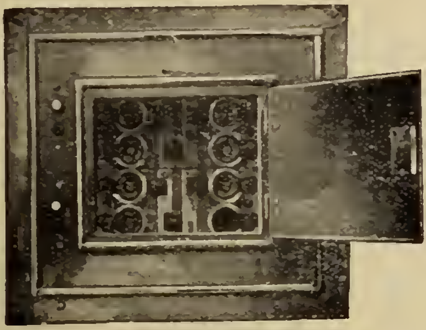
Daum Fuses are making good every day.

CATALOGUE NO. 17 for the asking

Sole Manufacturers
A. F. DAUM COMPANY, PITTSBURGH, PA.

ASK US about
Efficient
Lighting
for your streets, factory, warehouse
or yard

A. H. WINTER JOYNER, Ltd.
76 Bay Street, Toronto
"Consult A Specialist"



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COLUMBIA Push Button Switch Cabinets

Save Cost of Switch Box and Plates.

Push Button instead of knife switches eliminates all danger of accidental contact with live parts, besides assuring longer service, as it is well known that push button switches far outlast knife switches. These new cabinets are much superior to the regular panels and cabinets, they occupy less space and are lower in price. Lock type switches may be substituted for use in public halls, etc. Note the prices. Cabinets only.

		Prices			
Cat. No.	Circuits	List	Cat. No.	Circuits	List
511	2	$3.50	515	10	$5.50
512	4	4.00	516	12	6.00
513	6	4.50	517	14	6.50
514	8	5.00	518	16	7.00

Write for Bulletin and Discounts

Columbia Metal Box Co.

226-228 E. 144th Street. NEW YORK

"The Recognized Authority on Wiring and Construction"

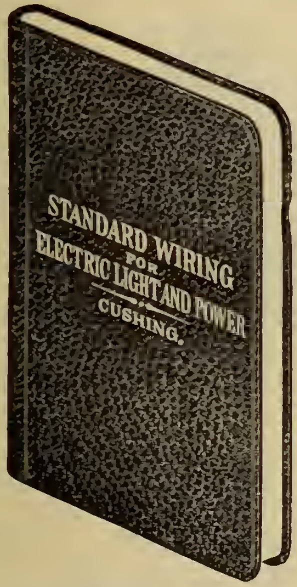
—The Electrical Journals of the United States, Canada and England

Over 297,000 Sold

By H. C. Cushing Jr.

Fellow American Institute of Electrical Engineers; formerly Electrical Inspector for Boston Board of Fire Underwriters and Underwriters' Tariff Association of New York.

20th Year **20th Edition**



1914 Standard Wiring

is the only book on Electric Light and Power Wiring and Construction endorsed and recommended by every Board of Fire Underwriters in the United States and Canada, because it is the only one kept strictly up-to-date and revised every year in accordance with every rule and requirement of the

National Electrical Code

which it contains, explained and illustrated. The 1914 Edition has been completely revised from the first to the last page, and contains new illustrations, tables and diagrams in accordance with the latest and best practice.

"It settles disputes and, if referred to before wiring, prevents disputes."

Sent to any address, postpaid, on receipt of **$1.00** Leather Cover Pocket Size

Electrical News, 220 King Street West, **Toronto, Canada**

"The Best Book on Wiring Ever Produced"—E. T. BIRDSALL, M.E., A.I.E.E.

Yager's Soldering Fluxes

Either of our four forms produces the same result—a perfect **Electrical** joint, tight, free from corrosion. **Yager's** Fluxes are non-acid and have proven absolutely efficient for 35 years of use. Test them at our expense and send us that order, or your jobber's name.

ALEX. R. BENSON CO.

HUDSON, N.Y.

SIMPLEX QUALITY

A Text Book for Gift Makers

at any time is our new booklet, "The Dainty Way to Keep House."

¶ It has interested thousands in lamp socket cooking and heating appliances of Simplex Quality.

¶ Your customers will be glad to receive it.

SIMPLEX ELECTRIC HEATING CO.

Mfrs. of Everything for Electric Heating and Cooking

BELLEVILLE, ONT.

CHICAGO, 15 S. Desplaines St. CAMBRIDGE, MASS.
SAN FRANCISCO, 612 Howard St.

The Electrical Engineering Co. of Toronto

130 Wellington Street West

ARE YOU CHANGING YOUR SERVICE FROM 60 TO 25 CYCLE, IF SO, HOW ABOUT THAT OLD MOTOR?

Better send it to the above address and have us re-design and re-wind it to suit your new current; and remember, all our re-winds, re-designs and alterations are carried out under expert designers and engineers, where the best of material and facilities are to be had, thus ensuring you every satisfaction.

Direct current motors and generators re-designed for any pressure.
Special transformers and choking coils made to order.

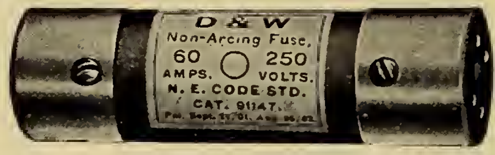
EXPERT REPAIR MEN TO BE HAD DAY OR NIGHT BY PHONING

Day Adelaide 3183 **Night College 2235**

When Perfection in Anything is Claimed

by a manufacturer, it means that he has set the highest possible standard on his goods, and it remains for the consumer to decide whether his claim is justified.

WE HAVE ALWAYS CLAIMED PERFECTION IN "D & W" FUSES



perfection in design, quality in material, and efficiency in operation. Sufficient endorsement of this claim has been furnished by the numerous repeat orders coming in.

D & W FUSE CO., Providence, R. I.

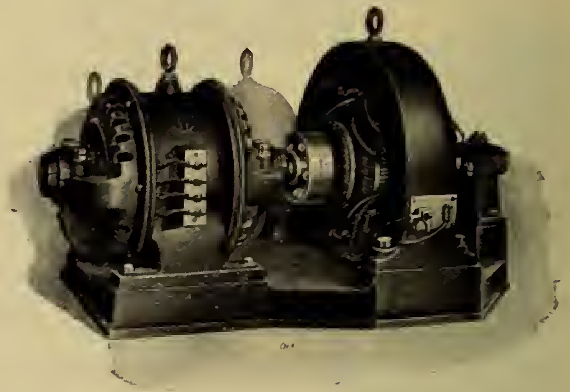
Canadian Representatives

THE Northern Electric AND MANUFACTURING CO. LIMITED

Montreal Halifax Toronto
Winnipeg Regina Calgary
Edmonton Vancouver

Toronto & Hamilton Electric Company

HAMILTON



Make

Motors for All Circuits,

Dynamos for Power and Light and Electroplating

Repairs executed neatly and promptly.
Write Us.

Tenders

A few dollars spent in advertising your proposals in

The Contract Record

would result in additional competition, which might save your city or town or your client many hundreds of dollars.

HOPE

Tapes and Webbings

for

Electrical Work

Write for Samples and Prices

Hope Webbing Company

Providence, R.I.

Special Prices

ON

Electrical Books

The Following Books are Offered Subject to Previous Sale

The Steam Turbine, by Robert M. Neilson. Published in 1903 by Longmans, Green & Co., 294 pages, illustrated. Price $1.00.

Telegraphy, by Sir W. H. Preece, K.C.B., and Sir J. Sivewright, M.A. Published in 1905 by Longmans, Green & Co., 504 pages. Price $1.00.

Electro-Dynamos, by Charles Ashley Carus-Wilson. Published in 1898 by Longmans, Green & Company, 298 pages. Price 50c.

Electrical Engineering, by Steinmetz. Published in 1909 by McGraw Hill Publishing Company. Price $3.00.

Radiation Light & Illumination, by Steinmetz. Published in 1909 by McGraw Hill Publishing Company. Price $2.50.

Electric Motors, by Crocker & Ardendt. Published in 1910 by D. Van Nostrand & Company. Price $2.00.

Direct & Alternating Current Manual, by Bedell. Published in 1911 by D. Van Nostrand & Company. Price $1.00.

Short Course in Testing Machinery, by Morecroft and Hehrs. Published in 1911 by D. Van Nostrand & Company. Price $1.

Dynamo Electrical Machinery, by Sheldon & Hausman. Published in 1910 by D. Van Nostrand & Company. Price $1.50.

Electricity—Experimentally and Practically Applied, by Ashe. Published in 1910 by D. Van Nostrand & Co. Price $1.00.

The Dynamo (2 volumes), by Hawkins & Wallis. Published in 1909 by Whittaker & Company. Price $4.00.

Steam Turbines, by Kennedy. Published in 1910 by Whittaker & Company. Price $1.00.

Dynamo-Electric Machinery, by Francis B. Crocker, E.M., Ph.D. Published in 1908 by American School of Correspondence. 236 pages, illustrated. Price $1.00.

Telephone Law, by A. H. McMillan. Published in 1908 by McGraw Publishing Company. 332 pages. Price $1.50.

Practical Methods of Electro-Chemistry, by F. M. Perkin, Ph.D. Published in 1905. 322 pages. Price $1.00.

Treatise on Thermodynamics, by Dr. Max. Planck. Published in 1903. 272 pages. Price $1.00.

Text-Book of Electrochemistry, by Svante Arrhenius. Published in 1902. 344 pages, illustrated. Price $1.00.

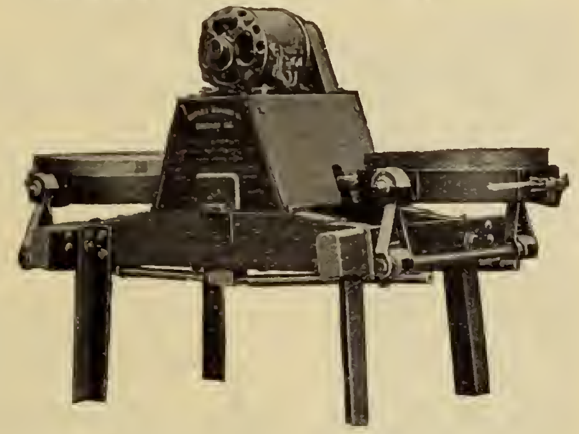
Electrical News

220 King Street West - Toronto, Ontario

Century

Single Phase Motors

Possess those keep-a-running qualities which are making single phase motors more popular every day.



¼ H.P. Motor geared to a foundry sand riddle.

They are built in sizes of ¼ to 40 H.P. for frequencies between 25 and 140 cycles, all with interchangeable voltage connections.

Bulletin No. 21 describes them.

CENTURY ELECTRIC COMPANY

19th., Pine and Olive Streets, St. Louis, Mo.

CANADIAN AGENTS

Jones & Moore Electric Co., Ltd.
294 Adelaide St. W., Toronto

Rudel-Belnap Machy. Co., Ltd.
Canadian Express Bldg., Mont.

Mainer Electric Co., Ltd.
Winnipeg and Edmonton

Rankin & Cherrill
517 Main St., Vancouver

You Save
MONEY and TROUBLE

All time saved from locating "grounds," cross-circuits—All lost current saved by reducing unnecessary resistance—means better service to your subscribers—money saved for you. Much of this trouble comes from joints soldered with inferior flux—corrosion and imperfect unions. Electrical experts and practical men know this—we have overwhelming proof on file. Also that

ALLEN-Flux

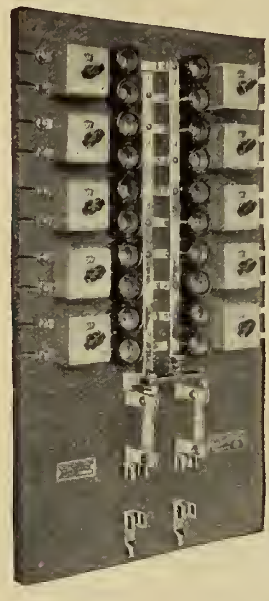
eliminates all this trouble and expense. Why? It is positively non-corrosive and—it has a powerful attraction for solder—makes a perfect joint every time. Flux has a vital bearing on your service and profits. It won't cost you a cent to prove that ALLEN-Flux does safer, better and quicker soldering. Your money back if not satisfactory. Made in a form for every use—Stik, Salts, Liquid, Presto-Soder and

ALLEN Soldering Paste

in cans and collapsible tubes with detachable aluminum nozzle.
Order it from your dealer, or send his name and we'll send you a sample. Do it to-day and satisfy yourself.

L. B. ALLEN CO., INC.
4546 N. Lincoln St., Chicago, U.S.A.
Houston & Co, Western Canada Agents,
557 Henry Ave., Winnipeg, Can.

FA PANEL BOARDS
AND
STEEL CABINETS



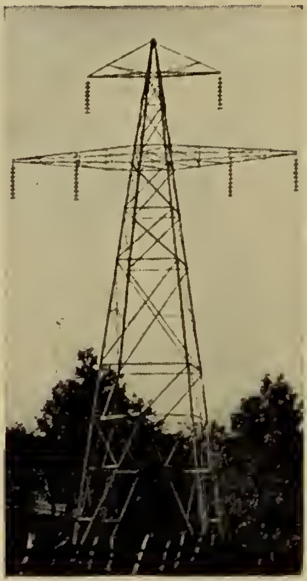
Meter
Control Panels
and
Switchboards
are built in
Standard and Special Designs
for both
A.C. and D.C. Light
and
Power Distribution.

Write for Catalog No. 18

For Special Material Use Our Same-Day-Received Quotation - Service.

FRANK ADAM ELECTRIC CO.
ST. LOUIS, MO., U. S. A.

TRANSMISSION TOWERS



DOUBLE CIRCUIT TOWER
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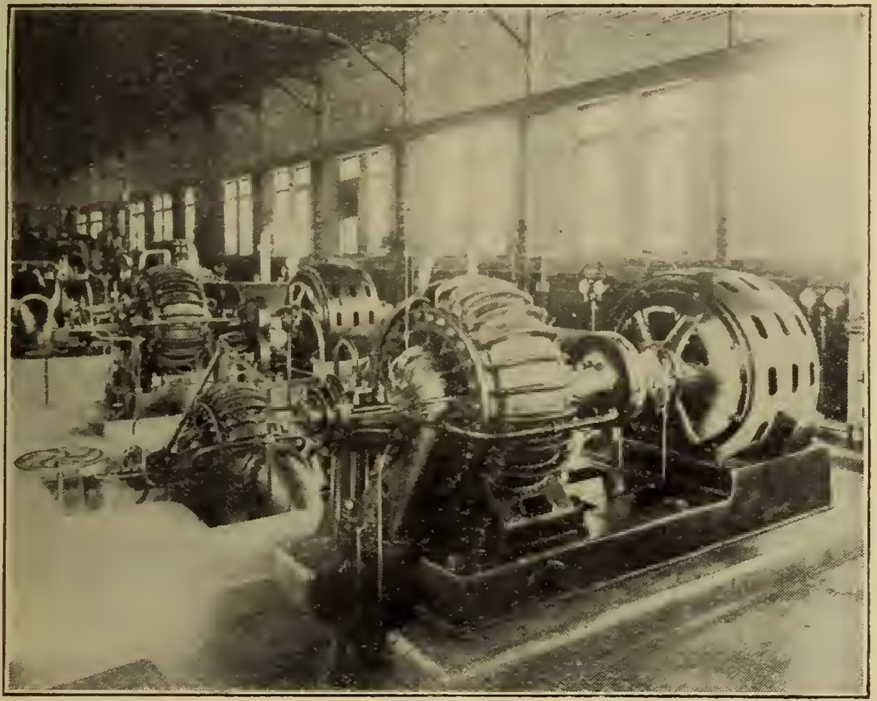

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'Elementary Telegraphy," by Pendry. Published in 1910 by Whittaker & Company. Price $1.00.

'Practical Testing of Electric Machines," by Oulton & Wilson. Published in 1909 by Whittaker & Company. Price 75c.

'Direct and Alternating Current Testing," by Bedell. Published in 1909 by D. Van Nostrand & Company. Price $2.00.

"A Laboratory Manual of Alternating Currents" by John H. Morecroft, E.E. Published in 1912 by Renouf Publishing Company. Price $2.00.

'Modern Electrical Construction," by Henry C. Horstmann and Victor H. Tousley. Published in 1911 by Frederick J. Drake & Co. Price $1.00.

"Electricians' Operating and Testing Manual," by Henry C. Horstmann and Victor H. Tousley. Published in 1910 by Frederick J. Drake & Company. Price $1.50.

"Telephony," by Samuel G. McMeen and Kempster B. Miller. Published in 1912 by the American School of Correspondence. Price $3.00.

"Elevators, Hydraulic & Electric," by Calvin F. Swingle. Published in 1910 by Frederick J. Drake & Company. Price $1.00.

"Practical Mathematics for the Engineer and Electrician," by Elmer E. Burns and Joseph G. Branch. Published in 1912 by the Joseph G. Branch Publishing Company. Price $1.00.

"The Electric Motor and Its Practical Operation," by Elmer E. Burns. Published in 1912 by Joseph G. Branch Publishing Company. Price $1.00.

"Electric Wiring & Lighting," by Charles E. Knox, E.E. Published in 1913 by the American School of Correspondence. Price $1.50.

"Electric Arcs," by Clement D. Child, Ph.D. Published in 1913 by D. Van Nostrand Company. Price $2.00.

"Conversations in Electricity," by Branch. Published in 1908 by the Branch Publishing Company. Price $2.00.

'A. C. Machinery," by Esty. Published in 1912 by the American School of Correspondence. Price $4.00.

'Wireless Telegraphy and Wireless Telephony," by Ashley-Hayward. Published in 1911 by the American School of Correspondence. Price $1.50.

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Electrical News

220 King Street West - Toronto, Ontario

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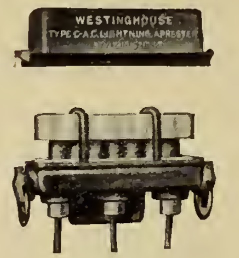
Westinghouse Lightning Arresters



Type C Lightning Arrester
Alternating Current
500—2500 Volts

are safe and reliable

They are made in types to meet every contingency of service.

Singly, or in combination, they provide effectual, adequate and reliable protection for generating and transmission systems of any capacity.

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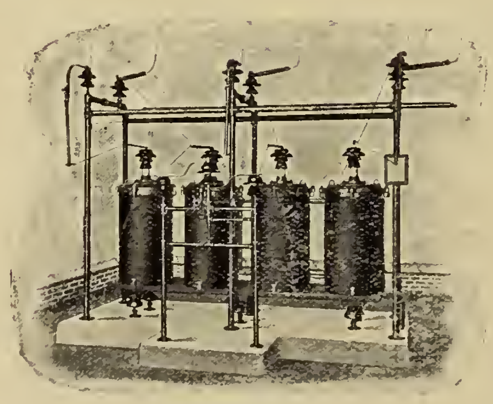

Type A Electrolytic Arrester
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2200 to 110,000 Volt

State your conditions and we will recommend the arrester, or combination of arresters, best suited to give you reliable protection. Our suggestions will not obligate you in any way. Consult our nearest office.

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The Filament is ANNEALED. If you have handled wire, you will know that a hard wire breaks easy, that if you anneal it, it will not break. The Annealing is the secret of this lamp's unparalled lasting quality.

But you will find many lamps that *last* because they have been made tough at the expense of efficiency.

NOTE THIS—The efficiency of this lamp is 1.1 Watts per candle.
It is remarkably tough when you first get it.
It is tougher after 200 or 300 hours' run than when first put in service.
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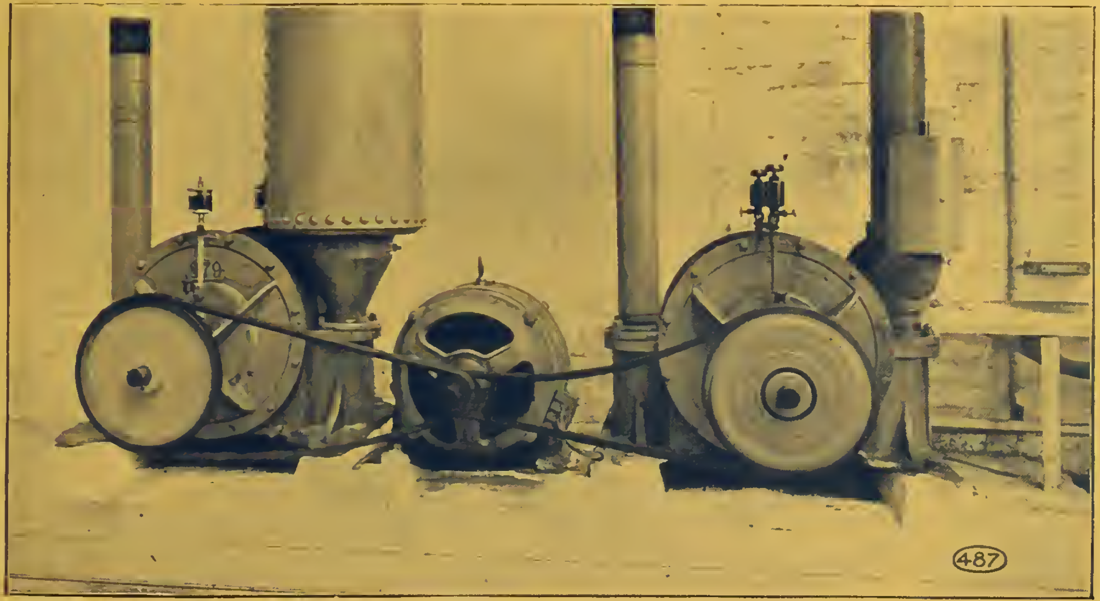
RENOLD PATENT SILENT CHAINS

Run equally well in either direction and not effected by Heat, Cold or Moisture.



Renold Chains driving two blowers, in motion, one with air vessel, the other without. The one to the right without air vessel is fitted with a spring cushion sprocket. Note the smooth running.

Write for illustrated Catalogue

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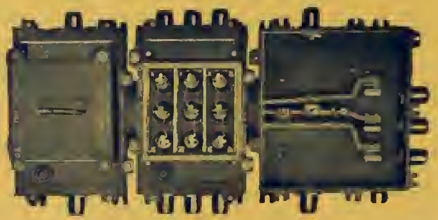
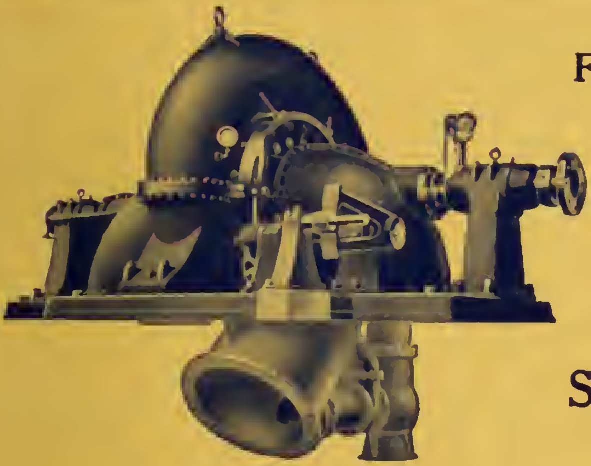


Vol. XXIII No. 6 Toronto, March 15, 191

Electrical News

Generation, Transmission and Application of Electricity



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Manufacturers of All Classes of Rotating Electrical Machinery

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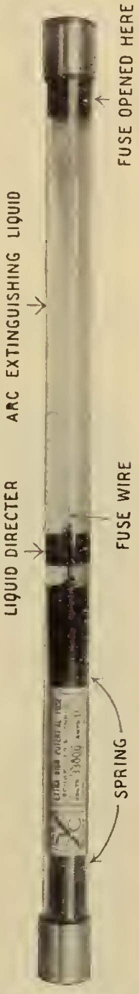
The Fuse Specialists in Canada

We can now serve your requirements promptly with protective Fuses for any voltage from ***1 to 150,000*** volts, in any commercial amperage. "S&C" Fuses, for use on lines of over 2,500 volts,—manufactured under Canadian Letters Patent, under date of April 30, 1912, by us as sole licensees—And Economy (Renewable) Fuses for 250 and 600 volt circuits. Protect your equipment from power house and transmission lines. To the smallest circuit and current consuming devices, thus, at every point and at all times providing "SAFETY FIRST" and "ECONOMY NEXT" to Life, Property and Electrical Equipments.

"S&C" Fuses are not an experiment, they have been in service for several years in the United States and many other countries with unparalleled success, and are far better and more reliable than the oil break switch commonly used for the same purpose.



"S&C" Fuse Before Blowing

"S&C" Extra High Potential Fuses Are rapid and positive in operation. Clear the circuit and limit the rush of current to a minimum. Do not endanger nearby apparatus. Effect a big saving in the investment. Facilitate the location of the trouble and blown fuses.

"S&C" Fuse After Blowing

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In every field where electricity is used for light or power, especially in industrial plants, the use of Renewable Cartridge Fuses is rapidly becoming standard practice.

A large number of buyers of Fuses have discarded the old fashioned method of using Non-renewal Fuses, and have standardized their electrical protective equipment by the exclusive use of

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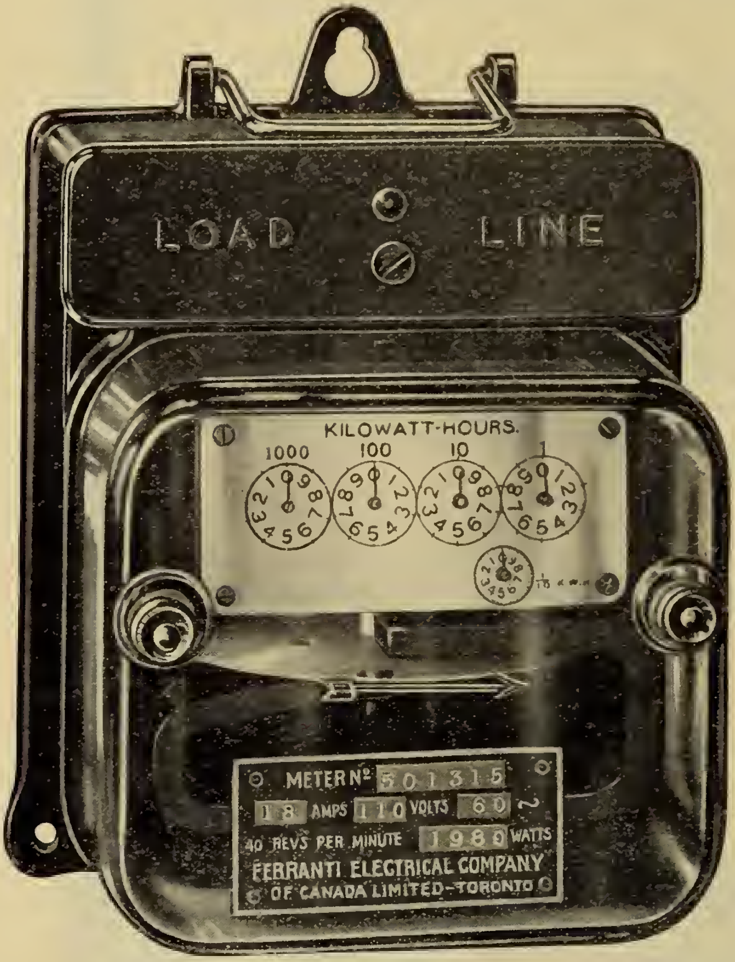
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We guarantee this meter equal to any other meter on the market.

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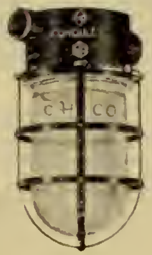
Type V



Type VC

Type VL

Type VT

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Type VA

Condulets of the V Series Provide the Means

Each Condulet as sold includes Casting, Lamp Receptacle, Sealing Plate, Gaskets, Globe and Guard.

Castings are made with from 1 to 4 threaded hubs, as shown in illustrations, into which the conduit carrying the wires is screwed.

Parts are easily adjusted and will not work loose as result of knocks or vibration.

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You Can't Lose and May Win by Mailing Attached Coupon Today

Crouse-Hinds Co. of Canada, Ltd.

Main Office and Works:

Toronto, Ontario, Canada

Kindly send me Condulet Catalogue.

Name..

Street..

County..

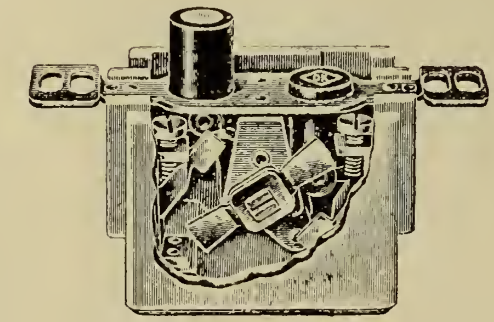
Prov..

E. N. 354

O. K.
TRADE MARK

Remember--If it's "OK" it's all right

"OK" Push Button Switch



(Flush Type)

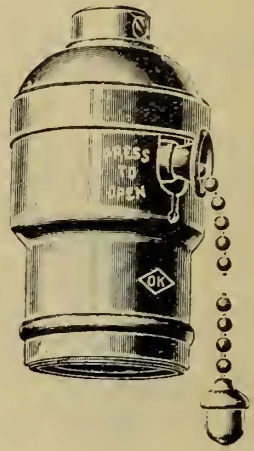
No. A231. This Push Button Switch is arranged to fit standard switch box. Each switch is packed separately in a card board box and is complete with fixing screws and washers.

This O.K. Switch is British made and the equal of any push button switch on the market.

Labelled by the Underwriters and tested by Canadian engineers at the factory.

All deliveries made from stock.

"OK" Pull Chain Socket



No. A566. This Pull Chain Socket is of the Double Break Type. The movement is enclosed in fibre lined brass shell secured by means of an automatic snap fastening which is interchangeable with other standard makes and is easily released (for Wiring-up).

Standard in every way.

Passed by the Underwriters' Laboratories. The only Pull Chain Socket made in Britain for Canadian use.

The smoothest and easiest working pull chain socket on the market.

Order by number.

Write and ask for our O. K. catalogue.

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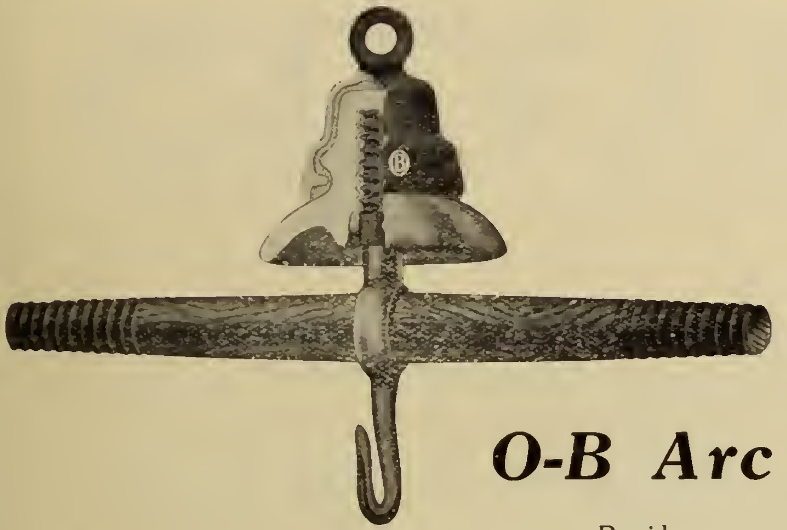
VANCOUVER WINNIPEG MONTREAL



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Provides a secure mechanical suspension and reliable insulation for arc lamps.

The insulating member is of high grade porcelain and is fitted with malleable iron cap and hook. Metal parts interlock with the porcelain and are cemented in place.

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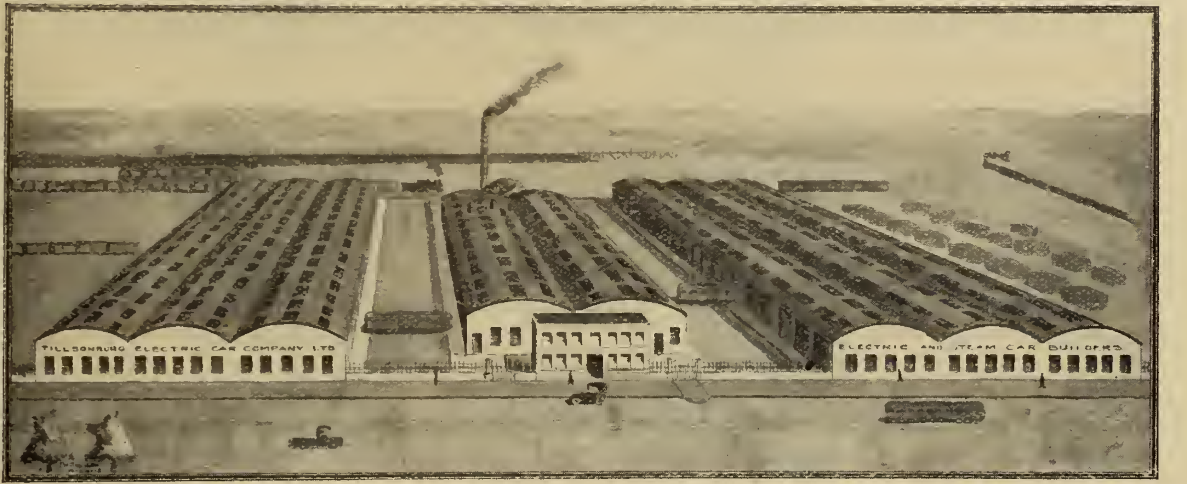
The Ohio Brass Co., Mansfield, Ohio, U.S.A.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The Tillsonburg Electric Car Co., Limited

Manufacturers of

ELECTRIC CARS, SWEEPERS AND SPRINKLERS

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Office and Works, - - Tillsonburg, Ontario

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GALVADUCT

Capitol Building, Edmonton. A "GALVADUCT" Bulding.

"GALVADUCT"

The most perfect interior construction conduit on the market.
Recognized as the standard of high quality.

Always specify Galvaduct or Loricated conduits

"LORICATED"

A high-class interior construction conduit of the enamelled type, proof against acid or other corrosive agents.

If your jobber cannot supply you—write us

Conduits Company Limited
Toronto - Montreal

LORICATED

One of a hundred adaptations of the

Campbell Automatic Time Switch

Switches any light, all lights, any time you wish.

Weather tight, gas tight, tamper tight—and you visit it once in 8 days.

Send for Catalog Lookit up.

Campbell Electric Co.

LYNN, MASS.

Canadian Representative—Irwin Smith, 809 Unity Bldg. Montreal

---

Electrical Supplies Warehouse Space

Adelaide St. W., Toronto

This new warehouse building will be well suited for the displaying and stocking of electrical supplies.

When completed this will be the most attractive warehouse building in the city. The exterior, the entrances, the elevators, etc., bear all the earmarks of a high class office building.

Special Features

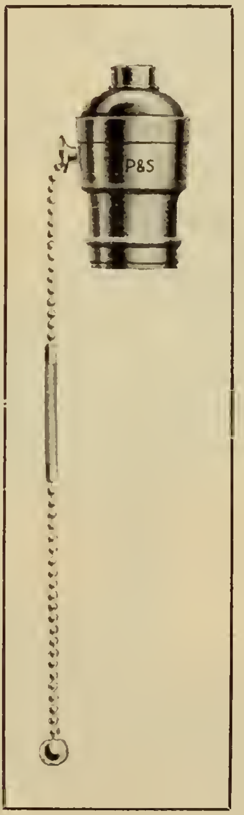
Centrally situated
Light on four sides
Passenger and freight elevator
Vaults
Low insurance
One block from four car lines
Floor area, 6,300 sq. feet, each floor.

For further particulars ask

R. A. Donald

Union Bank Building - Toronto

Protect Your Customers



When pull sockets are used over wash basins, stoves, radiators, registers, etc., you can offer your customer extra protection at small expense.

This is accomplished by using a chain, with fibre insulation, as illustrated.

The protection only adds 15 cents to the list price of the socket, and your customer will appreciate your thoughtfulness.

Do not forget to specify P & S *FLUTO* interchangeable shell on all pull sockets.

P & S Devices are carried in stock by all the leading Canadian Jobbers from Halifax to Vancouver

Pass & Seymour, Inc.

Main Office and Works, Solvay, New York, U.S.A.
San Francisco—Rialto Building

Rubber Covered Wires and Cables

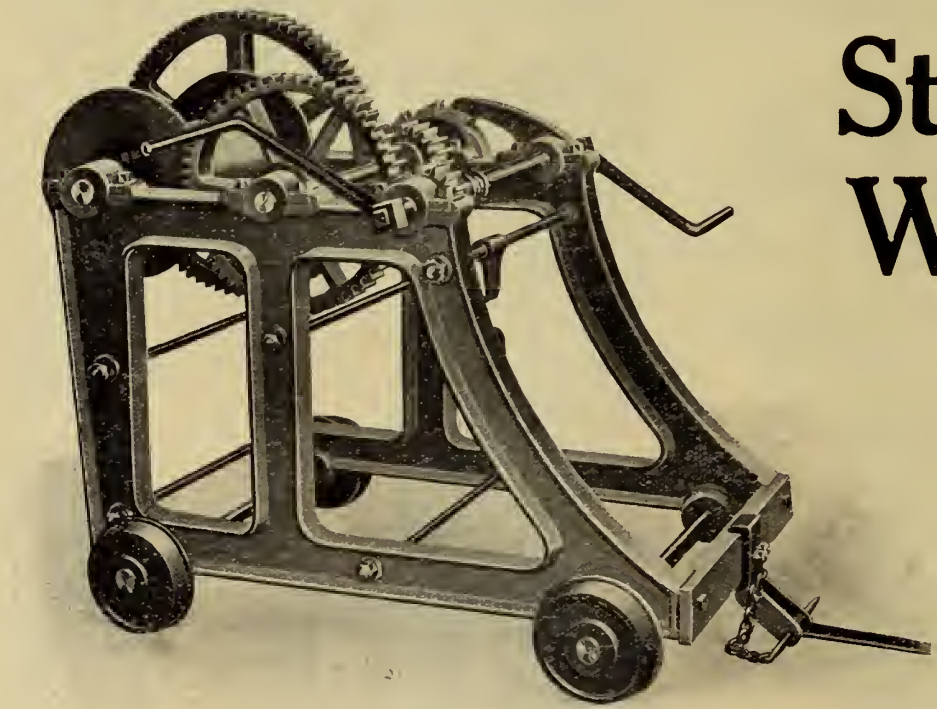
FOR POWER, LIGHT AND TELEPHONE WORK

Incandescent Lamp Cord, Flexible Switchboard Cables, Special Cords and Cables for all kinds of Electrical Work.

Prompt Shipments from Canadian Factory.

BOSTON INSULATED WIRE & CABLE COMPANY

Canadian Office and Factory, HAMILTON, ONT.



Stop Log Winches

These stop log winches are double geared, have an all iron frame and are strongly built and powerful in operation.

We build a complete line of winches, headgate hoists, sluice gates, etc., suitable for all conditions.

Catalogues and drawings on request.

William Hamilton Company, Limited

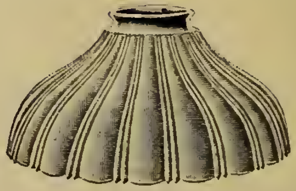
Peterborough, Ontario

MELILITE

Tungsten Reflectors

GILLINDER & SONS, INC.

PHILADELPHIA



Batteries Backed by a Guarantee to Give Satisfaction

Trade Mark Registered
Northern
Six
DRY BATTERY
DESIGNED ESPECIALLY FOR TELEPHONES, BELLS, SIGNALS AND ALL INTERMITTENT SERVICE
Every Cell Fully Guaranteed
Made in Canada
Northern Electric Company
LIMITED
MONTREAL WINNIPEG EDMONTON
HALIFAX REGINA VANCOUVER
TORONTO CALGARY VICTORIA

Large Stocks Carried at Each House Insures Prompt Shipments

TRADE MARK REGISTERED
Northern
Six
IGNITOR
DESIGNED ESPECIALLY FOR GASOLINE ENGINES MOTOR BOATS GAS ENGINES AUTOMOBILES AND GENERAL IGNITION WORK
EACH CELL FULLY GUARANTEED
MADE IN CANADA
Northern Electric Company
LIMITED
MONTREAL WINNIPEG EDMONTON
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IGNITOR
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Northern
EIGHT
IGNITOR
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TORONTO

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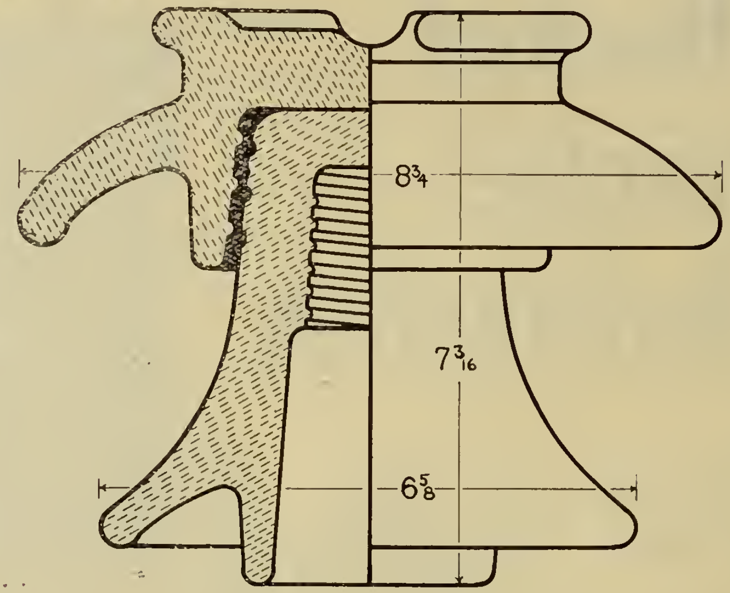
REGINA
CALGARY

EDMONTON
VANCOUVER
VICTORIA

CANADIAN INSULATORS

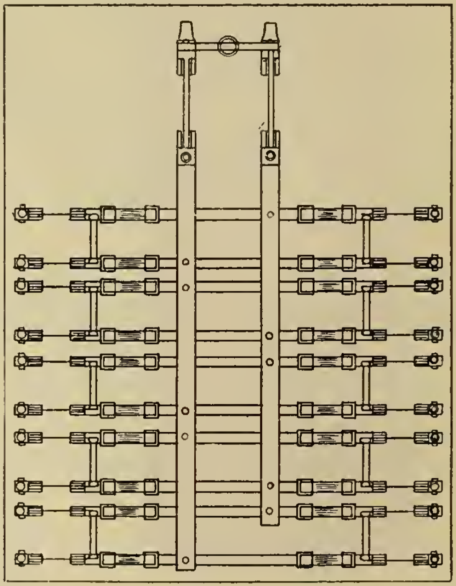


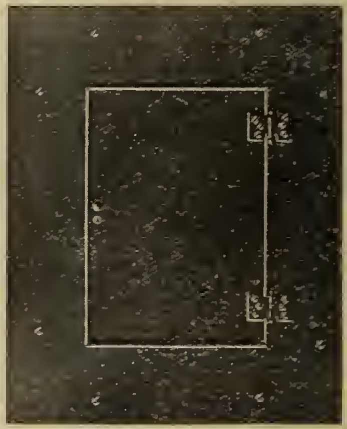
Number	133
Line voltage	30,000
Test voltage	100,000
Rain test	65,000
Leakage distance	17¾-in.
Pin hole	1⅜-in.
Net weight	10½-lbs.
Packed weight	12-lbs.
No. per crate	6

The Canadian Porcelain Company, Limited

HAMILTON, - CANADA

DEVOE PANELS





Panel Boards Our panels are well built meeting every underwriter requirement and are recommended and used by all leading Electrical Engineers and Contractors.
We can make any kind of Panel Boards and solicit your Specifications.

THE DEVOE ELECTRIC SWITCH COMPANY

157 Craig Street West, Montreal, Que.
Frank G. Scofield, Ontario Sales Representative, Lumsden Building, Toronto, Ontario

Our Improved
Type "K" Meter.

Why Not Buy Canadian made Meters?

" Packard " Meters have been manufactured in Canada for the past fifteen years.

There are over 70,000 in use at the present time throughout Canada.

Packard

Government re-inspections have proven the "Packard" to be a meter that will ***stand up*** and retain its accuracy of calibration over years of service.

Our improvements are all up-to-date and there is no better meter made anywhere.

The " Packard " may cost a little more at the start, but it saves money in the end.

Showing Improved
Magnet Support.

LARGE STOCKS CARRIED AT

St. Catharines and Winnipeg;
St. John Railway Co., St. John, N.B.;
General Supplies, Limited, Calgary, Alta.;
Rudel-Belnap Machinery Co., Canadian Express Bldg , Montreal, Que.

The Packard Electric Co., Limited

Factory at St. Catharines, Ont.

General Sales Office,
Traders Bank Bldg., TORONTO

N. W. Office and Warerooms,
WINNIPEG

Hold On

That is what you want your Rail Bonds to do. There are several kinds of bonds that will do it. There is ***one*** kind that not only will hold on, but absolutely will not corrode at the terminals.

Electric Welded bond terminals are guaranteed.

The Electric Railway Improvement Co.
Cleveland, Ohio

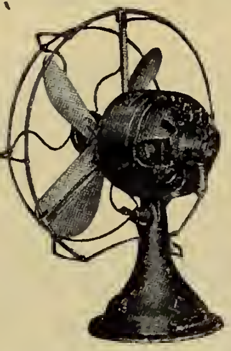
"SHAWMUT"
Electrical Material

- Enclosed Fuses
- Fuse Blocks
- Porcelain Cutouts
- Fuse Wire and Ribbon
- Fuse Links
- Ground Connection Clamps
- Nipples and Couplings
- Stage Pockets and Plugs
- Metal Cable Clips, Etc.

Manufactured by
CHASE-SHAWMUT CO.
Newburyport, Massachusetts

FRANK G. SCOFIELD
RERESENTATIVE FOR ONTARIO
702 LUMSDEN BLDG. - TORONTO, ONT.

ELECTRIC FANS



A.C. Desk Bracket Fan

D.C. Desk Bracket Fan

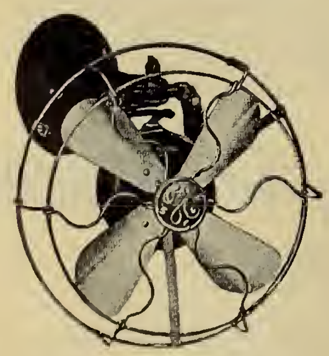
NEW DESIGNS

The line of CANADIAN GENERAL ELECTRIC FAN MOTORS for the season of 1914 comprises types not heretofore listed. The 12-inch alternating and direct current desk bracket fans have been greatly reduced in size and weight without sacrifice in output or efficiency. Distinctive features of design are maintained.

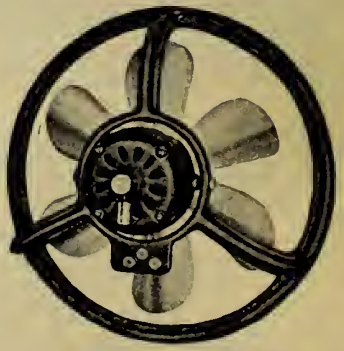
It is a notable fact that the electrical design for all Canadian General Electric alternating current fan motors is one which avoids the necessity of sliding contacts or other automatic features. This fact alone insures quiet operation, long life and highly satisfactory operating characteristics.

OUR DISTRICT OFFICES WILL GLADLY FURNISH PRICES AND DESCRIPTIVE MATTER.

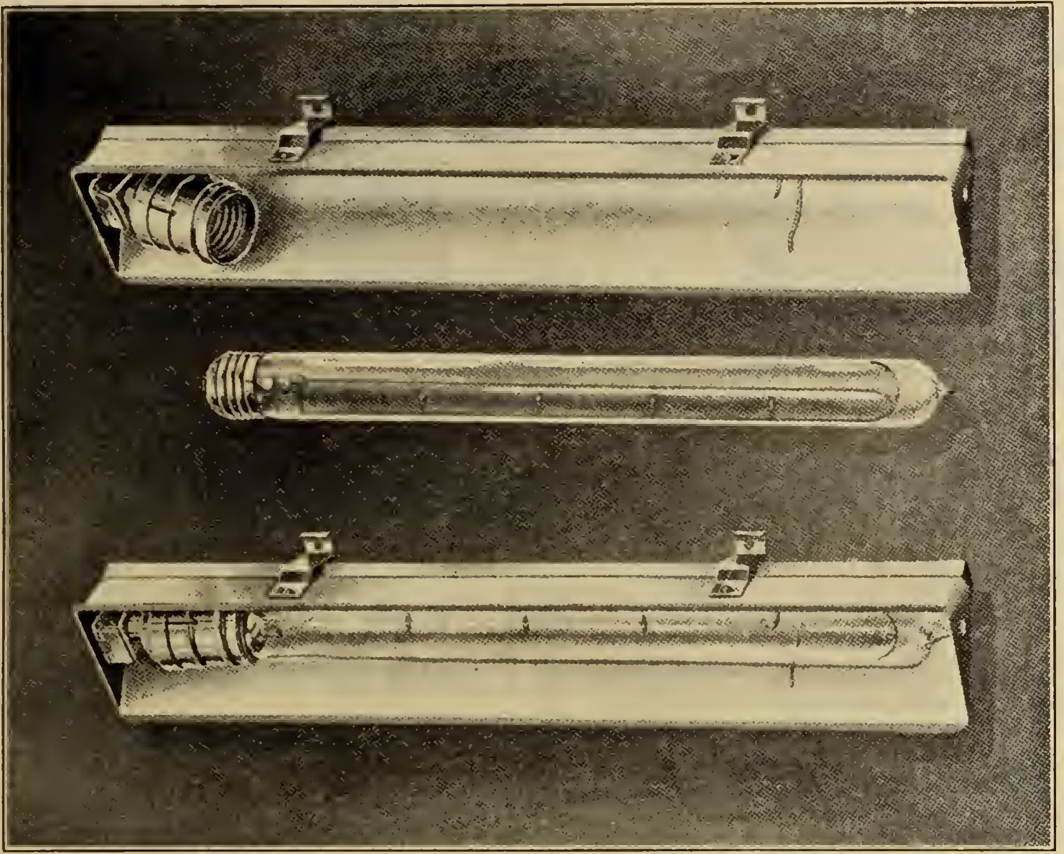
Canadian General Electric
Company, Limited
Head Office -TORONTO
District Sales Offices—Montreal, Halifax, Ottawa, Cobalt, Porcupine, Fort William, Winnipeg, Regina, Saskatoon, Calgary, Edmonton, Nelson, Vancouver, Victoria Prince Rupert.



Telephone Booth Fan



Small Ventilating Outfits



Light the Show Cases

Investigation shows that approximately fifty-one per cent. of all floor cases in department and dry goods stores are without lighting facilities; also that there has been an increase of two hundred per cent. in the number of show cases lighted during the past three years.

These two facts must suggest to the enterprising central station, electrical dealer and contractor the profitableness of going after this business and taking advantage of the opportunities presented by our

New Show Case Lighting Unit

The Lamp—The Mazda tubular lamp—one inch in diameter and twelve inches from contact of medium screw base to tip—is made in two wattages—25 and 40. The single drawn wire filament extending practically throughout the entire length of the bulb provides a running line of light.

The Reflector—The brass reflector when in position in the upper front angle of the show case occupies a space 14" long, 2½" wide and 2" deep. It has an interior finish of Cleanezy aluminum—the most efficient metal reflecting surface. The contour of the reflector is especially designed to present a neat appearance, to give the most effective distribution of light and to shield the eye from the dazzling bright filament. The unit is readily installed by raising the glass top of the show case, supporting the reflector from the upper edge of the upright glass by means of two brass brackets and then lowering the top. The lamp socket being mounted on a hinge facilitates the removal or insertion of the lamp. The latter when in the reflector is held rigidly by a wire clasp. A sliding brass moulding protects and conceals all wiring.

This show case lighting unit has just been placed on the market. It is bound to be a success. For additional information address

Canadian Sunbeam Lamp Co.

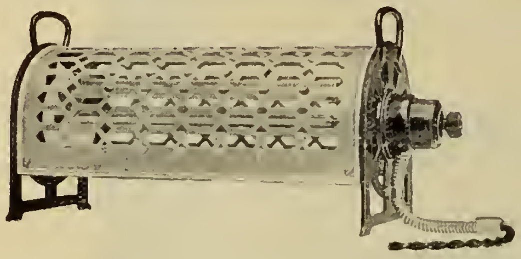
Limited

Main Office and Factory: TORONTO

—Branch Warehouses—

Montreal **Winnipeg** **Calgary** **Vancouver**

EARLY SPRING DAYS
ARE
BASTIAN HEATER DAYS



RED HOT GLOWING QUARTZ

Sizes—750 watts to 3,000 watts.

All Finishes—*Black Iron, Aluminum, Brass, White or Green Enamel.*

Special Designs for Grates, Mantels, Apartments, Residences.

THE MASCO COMPANY
LIMITED
50-68 Church St., Toronto

"Jobbers of Standard Electric Supplies"

The
Lachute Shuttle Co.
Limited
Lachute Mills, Que.

Manufacturers of

CROSS ARMS made from straight grained Douglas Fir, Long Leaf Yellow Pine and Red or Norway Pine.

The largest manufacturer of Cross Arms in the East.

INSULATOR TOP PINS made from Birch, Elm, Locust and Oak.

BRACKETS made from Birch and Oak.

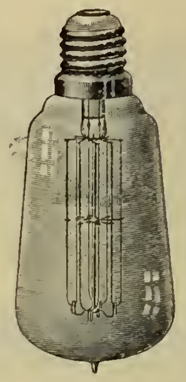
POLE STEPS made from Oak.

STRAIN PINS made from Second growth Hickory.

SPECIAL PINS for HIGH VOLTAGE TRANSMISSION made from Locust and Oak, all kinds and sizes.

All products boiled in Parafine and Stearine or Creosoted if wanted.

CORRESPONDENCE SOLICITED



GWIAZDA
TUNGSTEN LAMPS
Wire Drawn

One watt per candle power in all sizes. Best Quality

in stock at

G. LEWIS
Sole Agent

P. O. Box 1513 3 St. Nicholas St., MONTREAL

Street Illumination

By Multiples and Series

Pemco Fixtures

"The Practical Fixture"

Send for Bulletin No. 7

Philadelphia Electric and Mfg. Company
PHILADELPHIA, PA.

Canadian Representative
A. H. Winter Joyner, Limited
76 Bay Street, Toronto

ASK US about
Efficient Lighting
for your streets, factory, warehouse or yard

A. H. WINTER JOYNER, Ltd.
76 Bay Street, Toronto
"Consult A Specialist"

KIMBLE

VARIABLE SPEED MOTORS

are preferred by

Discriminating Motor Users

BECAUSE

They give varying speeds (every speed from 500 to 2,000 R.P.M.) without the use of resistances which are wasteful of power.

They start, stop, reverse and change speed by a single movement of the lever, without disturbing the circuit or damaging the windings.

They can be instantly reversed from full speed forward to full speed backward without damage. This feature makes them indestructible and fool proof.

The entire control of the motor including start, speed changes, stop and reverse, is secured by a single lever. This lever is a part of the motor itself. When the lever is on its "off point" no current is in the motor for the lever shuts it off the same as an outside switch.

Nothing could be more simple and effective.

They are very easily installed, the smaller sizes requiring only two wires direct from the plug to the terminals on the motor. All except the larger sizes can, with perfect results be connected up to any incandescent light sockets.

KIMBLE SINGLE PHASE VARIABLE SPEED MOTORS start with the full load torque. This insures their using no more current in starting than is used at full load. In the **KIMBLE** motor a given speed consumes only a given current, half that speed, half the current—with none of the current wasted in resistance coils, or other unnecessary attachments. Power waste is thereby reduced to the very minimum.

THEY ARE THE ACME OF PERFECTION

Write for Descriptive Literature

The Mainer Electric Company, Limited

WINNIPEG, MAN. - EDMONTON, ALTA.

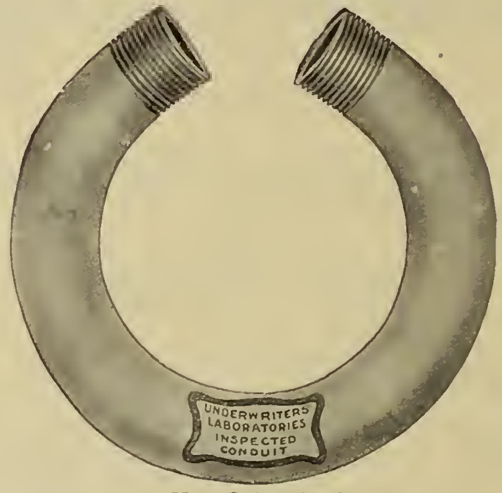
The Largest Electrical Supply House in the West

Conduit and Accessories

Approved by National Board of Fire Underwriters

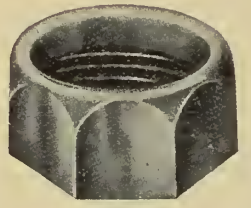
GREENFIELDUCT

No. 6350

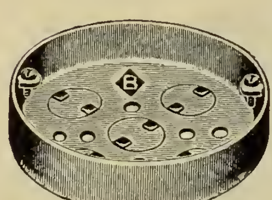


Hot Galvanized

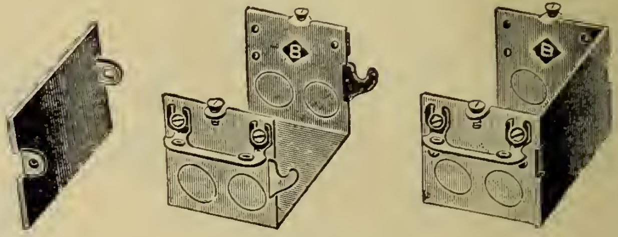
ALPHADUCT FLEXIBLE CONDUIT FOR ELECTRIC WIRES TRADE MARK



Bushing

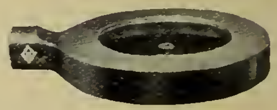


18 L



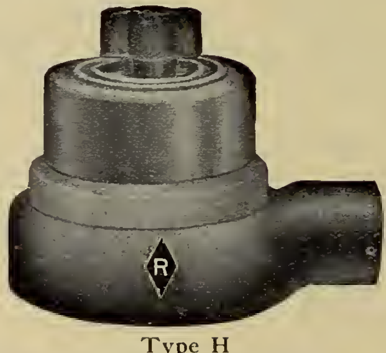
C C S Box

Type E



Type P

Type L B



Type H

Type J

Ask For Catalogue No. 4

Electrical Fittings Company, Limited

Toronto - Canada

I-T-E

CIRCUIT BREAKER

Every once in a while we do something foolish: most people do. We try to build a cheap circuit breaker and we always fail—it never comes out cheap.

I-T-E standards are too high, our Engineering Department designs too well, too good material is used, and too much of it, our shop work is too good, our finish is too fine, our tests are too exacting.

With us every man in his department is a specialist trained to do the best he knows how. Under these circumstances how can we build a cheap piece of apparatus? The answer is we cannot.

But give us a problem that demands the best, give us the most exacting conditions, and we make good.

The experience of twenty-five years is at your service.

The Cutter Company, Main Office and Factory **Philadelphia**

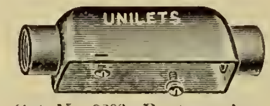
The Cutter Company, 120 Liberty Street, New York.
The Cutter Company, Monadnock Block, Chicago.
The Cutter Company, Park Building, Pittsburgh.
The Cutter Company, Traders Bank Bldg., Toronto, Canada.
The Cutter Company, Metropolitan Life Building, Minneapolis, Minn.

The Cutter Company, Telephone Building, Indianapolis.
The Cutter Company, Woodward Building, Washington, D.C.
The Cutter Company, Ford Building, Detroit.
The Cutter Company, Pabst Building, Milwaukee.
Eccles & Smith Co., Los Angeles, San Francisco, Portland, Ore.
Frank Darling & Co., Vancouver, B. C.
Electric Manufacturers Sales Company, Denver

"UNILETS"

are drawn from steel and possess many merits which are an absolute necessity for up-to-date conduit work. For durability, neatness, space for making wire connections, "Unilets" meet all requirements. "UNILETS" are mechanically right. The conduit is steel, why not the fitting? Try them on your next job. Copy of booklet "UNILETS" mailed on request.

Cat. No. 9001—Rectangular Unilet.

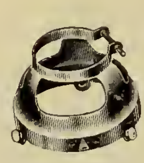


Cat. No. 9202—Rectangular Unilet.

Type No. 2—Rectangular Unilet. Cat. No. 9002 with No. 7650 Receptacle.

Type No. 1 Octagon Unilet. Cat. No. 7501.

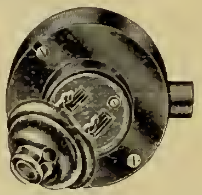
Type No. 4— Round Unilet with enclosed Snap Switch.



Cat. No. 7322—Shade Holder

Cat. No. 6906 Vapor-Proof Unilet.

Combination Plug Receptacle and Push Button Switch Unilet—Hubbell Plug Receptacle and Arrow E Push Button Switch Attached.



Type No. 1—4-inch Round Unilet with Two-phase Receptacle Attached.

Type No. 2 – Switch Unilet. Cat. No. 6501. with Push Button Switch Attached.

ADDRESS DEPT. "D" FOR COPY OF BOOKLET

APPLETON ELECTRIC COMPANY

Main Office and Factory **CHICAGO** 212-214 N. Jefferson Street

For Sale in Canada by

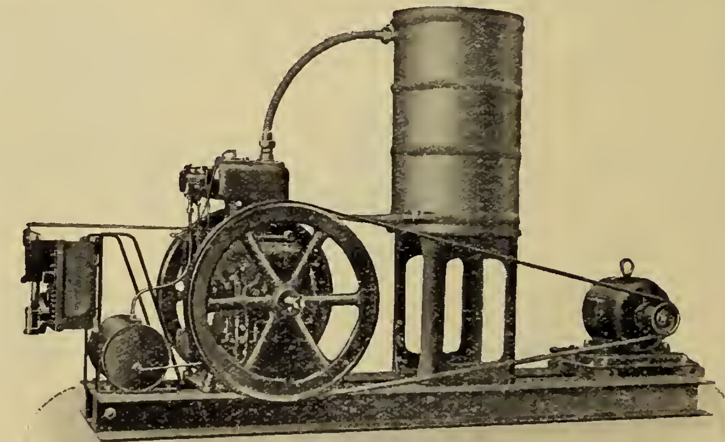
The Mainer Electric Co., Ltd., Winnipeg **Marshall-Wells Co., Ltd., Winnipeg** **Chapman & Walker Ltd., Toronto**

The LISTER-BRUSTON

AUTOMATIC ELECTRIC LIGHTING PLANT

Are you interested in the lighting of

Country Houses
Hotels
Summer Homes
Churches
Factories
Small Towns
Villages?



A Few Purchasers

Canadian Bank of Commerce. 8 plants.
Shawville Municipality, Que. 2 plants.
House of Refuge, Cornwall, Ont.
Cleveland House, Hotel, Minett P.O., Ont.
Campbell Reeves, Esq. (Jno. Inglis Co.), Toronto.
R. A. Manning, Esq., Barrie, Ont.
Dr. Ellen Burt-Sherratt, 7 Dundonald St., Toronto.
R. Scoles, Esq., New Carlisle, Que.
W. Mosley, Esq., Weston, Ont.
R. Gordon Stewart, Esq., Ottawa, Ont.
N. Trotter, Esq., Little Current, Manitoulin Island, Ont.
Chas. Lewis, Esq., Lansing, Ont.

THIS PLANT generates electricity automatically and does away with the necessity of large expensive storage batteries. With the exception of keeping it clean, lubricating and filling the gasoline supply tank, no attention is required. In addition to these advantages the first cost is low, space required small and no foundations are necessary. It is delivered practically ready for connecting up to the house wiring, and can consequently be used within a few hours of being unpacked.

R. A. LISTER & COMPANY, LIMITED

Winnipeg **58-60 Stewart St., TORONTO** **St. John, N. B.**

"Monarch Pull Socket"

ALL CANADIAN

Created in Canada
Made in Canada
Patented in Canada
For Canadians
Why not save duty charges

Snap cap and shell

These sockets have been in satisfactory service for a year.

Made and sold by

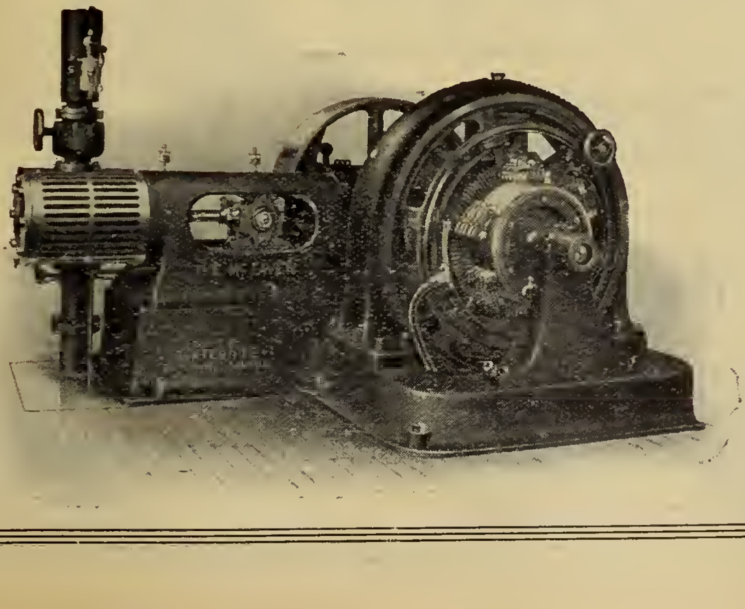
Monarch Electric Company, Limited
ST. LAMBERT, QUE.

Write for prices

Continuous Power For Industrial Use

A McEwen Engine in your Power Plant is your best guarantee against shut-downs and large repair bills. Your plant is not at the mercy of the elements—there are no tie-ups because "something has gone wrong on the transmission line." McEwen Engines are sold on a basis of quality—of economical initial performance—that is maintained year after year.

McEWEN ENGINES



Improve with use.

A simple and sturdy design—steam valves that are absolutely tight—a governor that permits of the closest regulation—an oiling system that gives perfect lubrication—These are some of the features that have placed McEwen Engines in hundreds of steam plants in Canada.

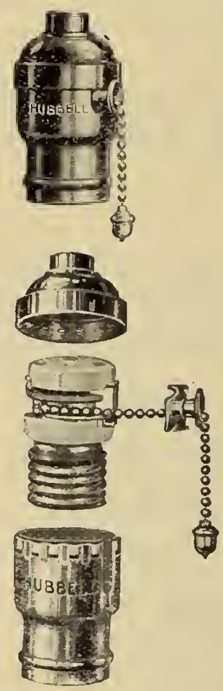
Write for McEwen Booklet

The Waterous Engine Works
Company, Limited
BRANTFORD - CANADA

ALUMINUM
ELECTRICAL CONDUCTORS
Ingot Sheet Wire Rod Tubing
Northern Aluminum Co. Limited
1305-6 Traders Bank Bldg.
Toronto, Ont.

FELTS
Dust and Oil Rings, Buffers, Lubricating Pads, Wicks for Fan Motors, and felts of every kind for electrical and mechanical uses.
The Booth Felt Co., Limited
GANANOQUE, ONT., CANADA

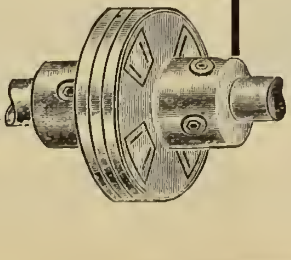
You'll Never Have Trouble With
HUBBELL Presturn Sockets
Pull Key and Keyless, all Bases



The deeds of Hubbell Sockets during their eighteen years of existence prove conclusively that Hubbell quality wins where quality begins—inside the socket shell.
There are housed the works that work as they should and must, to render substantial service.
Every Hubbell Pull Socket is regulated to the nicety of a watch. The action is smooth, firm, vigorous. Friction is reduced to the least possible degree to insure against break-downs under constant use.
To the Hubbell sturdy mechanism has been added the new Presturn Shell. It has nineteen adjusting points, each a secure locking point. Presturn Shells are simple to adjust, readily taken apart, secure under the weight of the heaviest lamp and shade. Ask for a sample Presturn Socket.
R. E. T. PRINGLE, 519 Can. Express Bldg. MONTREAL

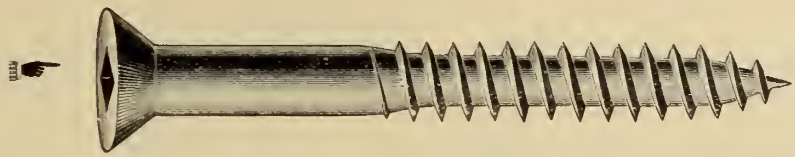
We Purchase Outright entire issues of bonds on steam and electric railroad, gas-electric and hydro-electric properties.
N. W. HARRIS & CO.
Established 1882
Incorporated 1911
35 Federal Street, Boston, U.S.A.

This Coupling INSULATES
—is highly powerful, absolutely positive and silent. Adapts itself to drives in which shafts are not well aligned, and runs either way. Practically indestructible, and needs no repairs. Always specify the **Grundy Flexible Coupling.** *Write for particulars and prices NOW.*
Canadian Bond Hanger & Coupling Co., Limited
Alexandria, Ont.

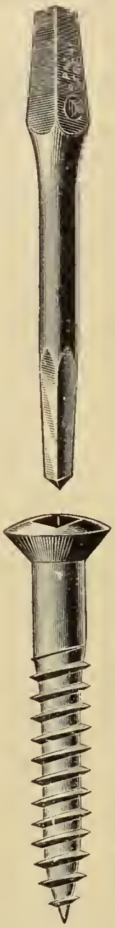


CHAIN-BLOCKS
ALL SHIPPED
THE DAY ORDER
IS RECEIVED.
THE HERBERT MORRIS CRANE & HOIST CO.
LIMITED,
EMPRESS WORKS,
PETER STREET,
TORONTO, ONT.
BRANCH OFFICE,
CORISTINE BLDG.,
MONTREAL QUE.

SEE
THAT
SQUARE
HOLE



PAT. FEB. 2, 1909



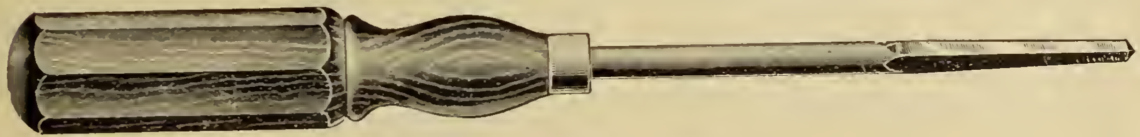
SOCKET HEAD
Wood Screws

The advantages of this wood screw are many. The screw may be placed on the driver and driven at arms length, with one hand. It is impossible for the driver to slip out of the socket.

Drivers are made in a variety of suitable styles.

For electrical wiring and fixture work, etc. this type of screw is unrivalled.

Samples, prices and catalogue on request.



The P. L. Robertson Manufacturing Co., Ltd.
Milton — Ontario

"Eclipse" Electric Heaters

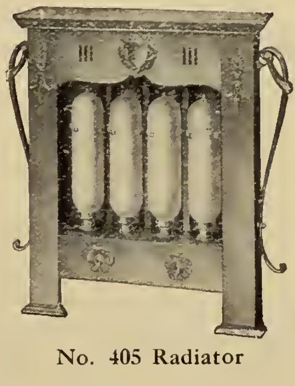
5 Years Guarantee

No. 332 Connector

A patented System, in Successful use all over the World.

Our Catalogue illustrates and describes our 100 patterns.

No. 388 Train and Car Heater



No. 405 Radiator

Can be procured in Canada from the Supply Authorities, Electrical Dealers, or from our Montreal office as under.

The Electric & Ordnance Accessories Company Limited
Head Office for Canada :—LEWIS BLDG., MONTREAL
Mr. J. P. I. Thomas (Representative)
Works :—Aston, Birmingham
ENGLAND

Electrical Books

FOR SALE

"Tesla High Frequency Coil," by Haller & Cunningham. Published in 1910 by D. Van Nostrand & Company. Price $1.25.

'Elementary Telegraphy," by Pendry. Published in 1910 by Whittaker & Company. Price $1.00.

'Practical Testing of Electric Machines," by Oulton & Wilson. Published in 1909 by Whittaker & Company. Price 75c.

'Direct and Alternating Current Testing," by Bedell. Published in 1909 by D. Van Nostrand & Company. Price $2.00.

"A Laboratory Manual of Alternating Currents" by John H. Morecroft, E.E. Published in 1912 by Renouf Publishing Company. Price $2.00.

"Electricians' Operating and Testing Manual," by Henry C. Horstmann and Victor H. Tousley. Published in 1910 by Frederick J. Drake & Company. Price $1.50.

"Telephony," by Samuel G. McMeen and Kempster B. Miller. Published in 1912 by the American School of Correspondence. Price $3.00.

"Elevators, Hydraulic & Electric," by Calvin F. Swingle. Published in 1910 by Frederick J. Drake & Company. Price $1.00.

"Practical Mathematics for the Engineer and Electrician," by Elmer E. Burns and Joseph G. Branch. Published in 1912 by the Joseph G. Branch Publishing Company. Price $1.00.

"The Electric Motor and Its Practical Operation," by Elmer E. Burns. Published in 1912 by Joseph G. Branch Publishing Company. Price $1.00.

"Electric Wiring & Lighting," by Charles E. Knox. E.E. Published in 1913 by the American School of Correspondence. Price $1.50.

"Electric Arcs," by Clement D. Child, Ph.D. Published in 1913 by D. Van Nostrand Company. Price $2.00.

"Conversations in Electricity," by Branch. Published in 1908 by the Branch Publishing Company. Price $2.00.

'A. C. Machinery," by Esty. Published in 1912 by the American School of Correspondence. Price $4.00.

'Wireless Telegraphy and Wireless Telephony," by Ashley-Hayward. Published in 1911 by the American School of Correspondence. Price $1.50.

"American Electricians' Handbook," byTerrell Croft. Published in 1913 by McGraw-Hill Book Company, Inc. 750 pages, illustrated. Price $3.00.

Order at once if interested.

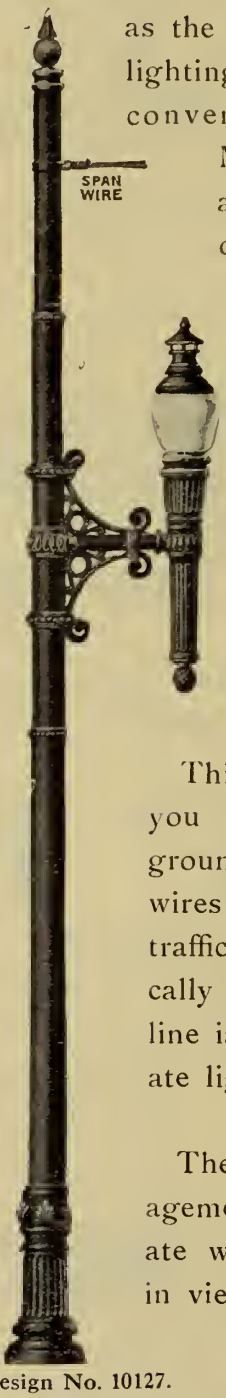
Book Department

Electrical News

220 King Street West - Toronto, Ontario

Use the Railway's Trolley Poles

as the basis of your new street lighting system. You can easily convert them into attractive Mazda Lamp Standards or arc lamp supports by use of



ERECO Combination Railway Lighting Pole Fixtures

This system, besides saving you the expense of underground construction, gets the wires up out of the way of traffic, where they are practically unnoticeable and the curb line is not crowded with separate lighting standards.

The progressive railway management will gladly co-operate with you with this object in view.

Design No. 10127.

Electric Railway Equipment Co.

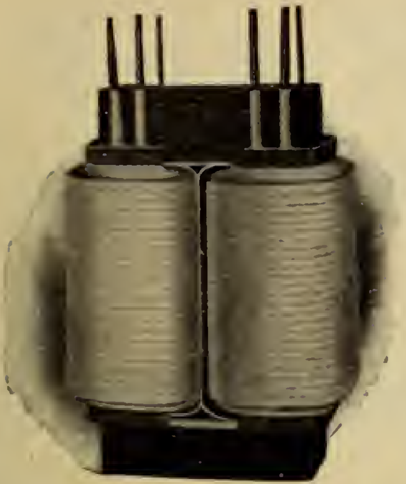
Cincinnati, Ohio

Designers **Manufacturers**

Canadian Representatives:

Dawson & Co., Limited, Montreal, Winnipeg

N. Y. Office, 30 Church St., Hudson Terminal Bldg.



Low Temperature Rise

THE extremely low temperature of rise of Moloney H. E. Transformers prevents the deterioration of the insulation, also the ageing of iron, and therefore removes the limitation of output.

Copper coils are outside of the core, causing the heat of the coils to be easily and rapidly dissipated outward in a constantly increasing circle to the exterior of the transformer case.

The maintenance of low temperature in Moloney transformers effects a great saving in their operation and maintenance.

To Central Station Men

A special line in the manufacture of Moloney Transformers is our PIPE THAWING TRANSFORMER. One of these in your Central Station means a paying proposition to you. This is the season for their use. Write us at once for full particulars and prices on Moloney Pipe Thawing Transformers. They last a lifetime.

Write for the Moloney Catalogue

Moloney Electric Company
of Canada, Limited
WINDSOR, ONTARIO

Factories at Windsor, Ont. and St. Louis, Mo., U. S. A.

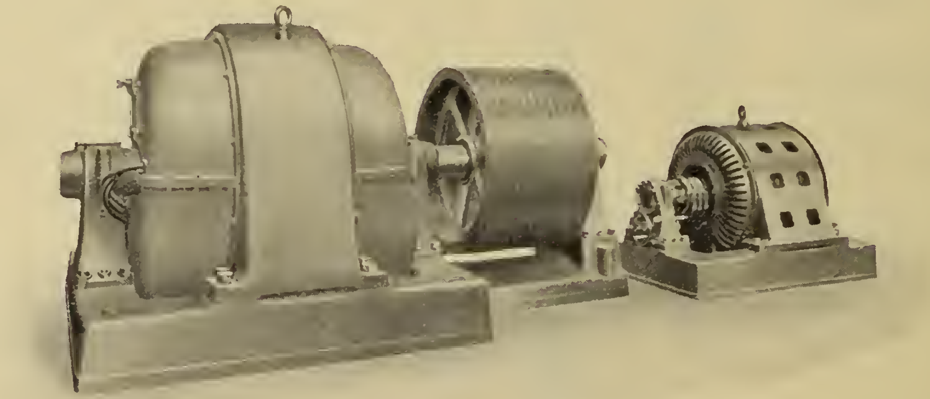
825 Vancouver Block, Vancouver, B.C., Canada
901 New Electrical Chamber, Winnipeg, Man., Canada
1001 C. P. R. Building, Toronto, Ont., Can.
400 Lake of the Woods Building, Montreal, Quebec

Complete Stocks at **Windsor, Winnipeg, Vancouver**

Swedish Electrical Machinery

NOTED FOR

Efficiency and Workmanship



1-340 H. P. 60 Cycle, 3 Phase, 2200 Volt, 350 r.p.m., 3 Bearing, totally enclosed induction Motor.

1-400 H. P. 60 Cycle, 3 Phase, 2200 Volt, 3400 r.p.m. 2 Bearing Induction Motor for direct connection.

We select your specifications for Electrical Equipment

BURNHAM ENGINEERING COMPANY

LIMITED

Canadian Dealers for

The Amalgamated Electric Company of Sweden

Head Office:
Traders Bank Building,
TORONTO

Montreal Representatives:
Rudel Belnap Machinery Co., Ltd.
Canadian Express Bldg.

You Save MONEY and TROUBLE

All time saved from locating "grounds," cross-circuits—All lost current saved by reducing unnecessary resistance means better service to your subscribers—money saved for you. Much of this trouble comes from joints soldered with inferior flux corrosion and imperfect unions. Electrical experts and practical men know this—we have overwhelming proof on file. Also that

ALLEN-Flux

eliminates all this trouble and expense. Why? It is positively non-corrosive and—it has a powerful attraction for solder—makes a perfect joint every time. Flux has a vital bearing on your service and profits. It won't cost you a cent to prove that ALLEN-Flux does safer, better and quicker soldering. Your money back if not satisfactory. Made in a form for every use—Stik, Salts. Liquid, Presto-Soder and

ALLEN Soldering Paste

in cans and collapsible tubes with detachable aluminum nozzle.

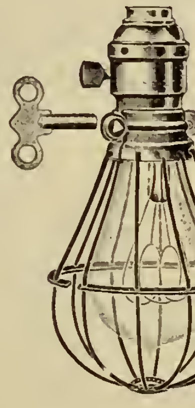
Order it from your dealer, or send his name and we'll send you a sample. Do it to-day and satisfy yourself.

L. B. ALLEN CO., INC.
4546 N. Lincoln St., Chicago, U.S.A.
Houston & Co, Western Canada Agents,
557 Henry Ave., Winnipeg, Can.

TRADE MARK ALLEN REGISTERED

LOXON
LAMP GUARD
THE KEY TO SAFETY

The Logical Guard To Use and Sell



It should not take much argument to convince any dealer, jobber or central station that Loxon is the satisfactory guard to sell; nor a lamp consumer that it's the best to use.

It's double protective feature Absolute Safety against both Breakage and Theft, give it a selling value you can't get away from. Its reasonable cost to users, a good profit for dealers—make it the right guard to push.

Fall and Winter is the time when Loxons save big money.

Make no mistake—

Get the genuine Loxon—Made only by

McGill Mfg. Co. 5 Oak St., Valparaiso, Ind.

WATERWORKS PUMPS

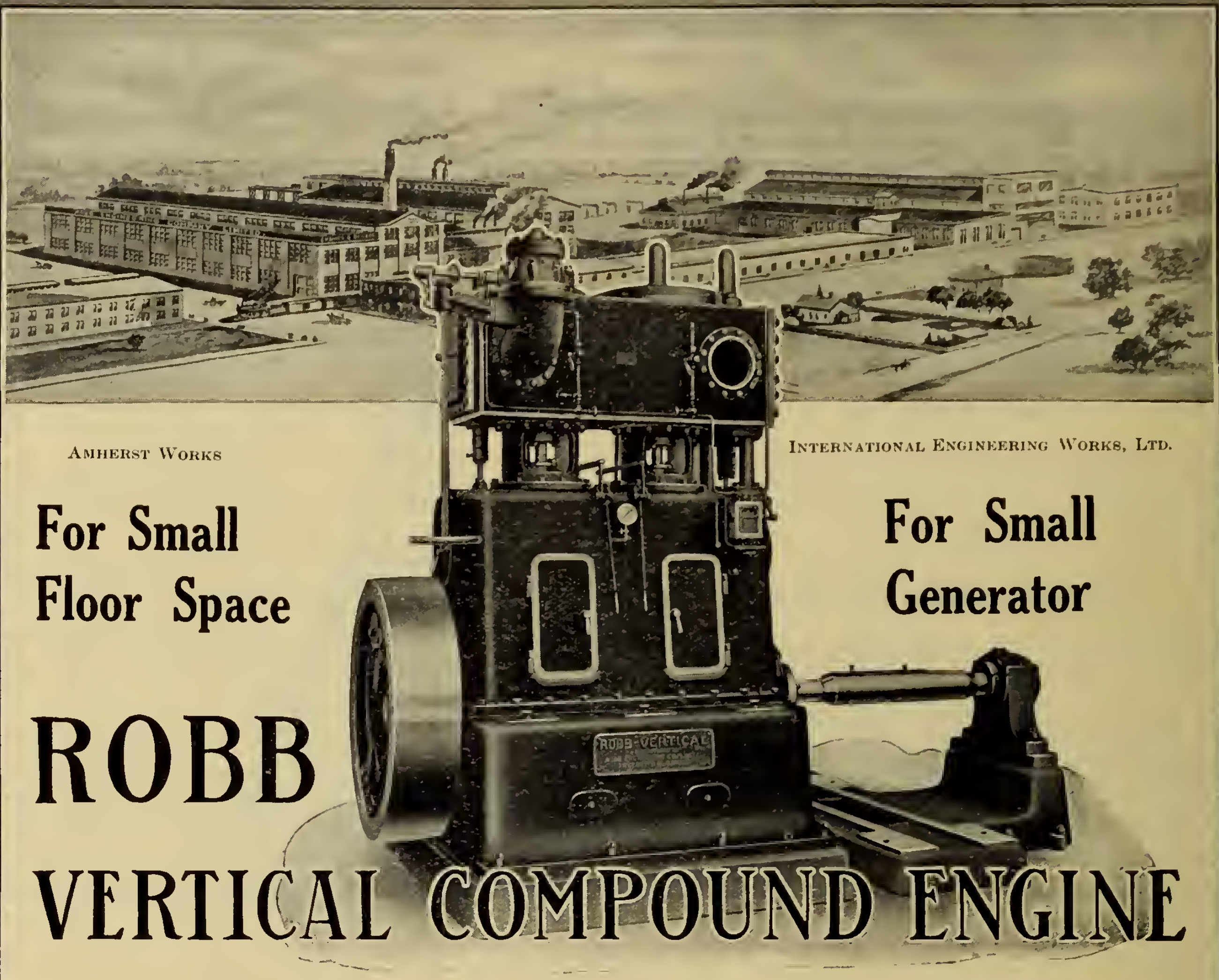
High duty horizontal compound and Vertical triple expansion

PUMPING ENGINES

Capacities from one-half million to thirty million gallons per twenty four hours.

Specifications on Request

THE JOHN INGLIS CO., LIMITED
Boilermakers and Engineers
14 STRACHAN AVE. TORONTO, CANADA
Montreal Office:—Room 509 Canadian Express Building



AMHERST WORKS

INTERNATIONAL ENGINEERING WORKS, LTD.

For Small Floor Space

For Small Generator

ROBB

VERTICAL COMPOUND ENGINE

High Speeds of Rotation with pistons of large diameter give a powerful engine in small space. The direct-connected generator can be of small diameter because of the high speed so that the unit will be of relatively low cost and small dimensions for a given kilowatt output.

Quiet and satisfactory operation at piston speeds of only 500 to 800 feet per minute make these engines particularly adapted to electric light plants and electric railway service—installations requiring high-grade durable engines which will operate under a great range of load.

Long periods of operation without attention are made possible by the system of forced lubrication which supplies all bearings with an abundance of oil.

Complete enclosure of all moving parts prevents oil from flying about and protects the parts from accidental injury.

Low Steam Consumption is due to the very small clearances, high speed, automatic governing, and refinement in finish.

Ask for Bulletin No. 201.

INTERNATIONAL

ENGINEERING WORKS, LIMITED

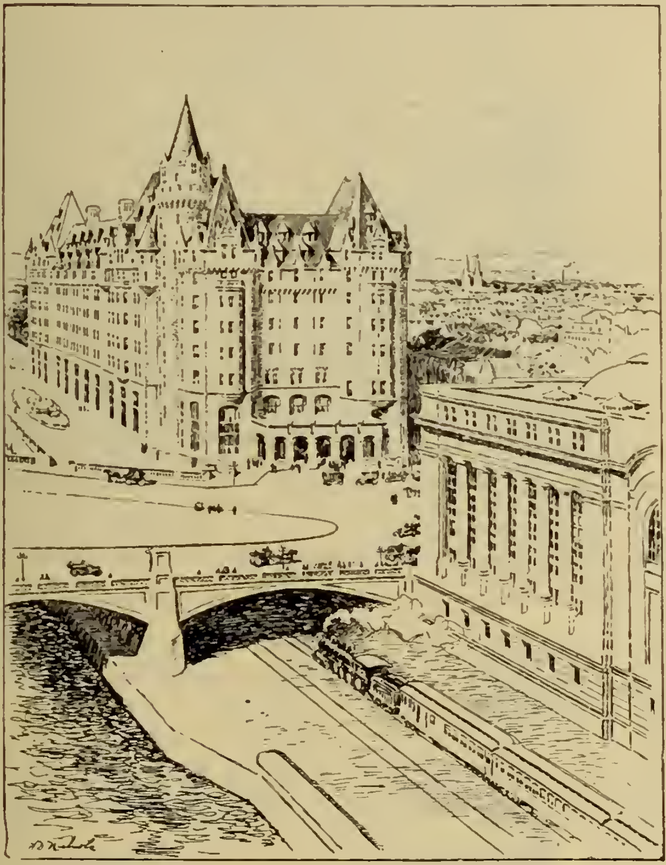
SO. FRAMINGHAM, MASS. AMHERST, N.S.

Montreal Winnipeg Edmonton Toronto Vancouver Calgary

39-70

Across Canada with the
IMPERIAL WIRE & CABLE CO.
LIMITED

Toronto - MONTREAL - Winnipeg



Second of a series of advertisements showing buildings of national importance which have been wired with Imperial Wire & Cable Co.'s, Limited, wires.

This picture shows
Chateau Laurier
and
Grand Trunk Central
Station, Ottawa

These buildings were wired throughout with "ADANAC" Rubber Insulated Wire

Architects: Ross & McFarlane, Montreal.
Engineers: Westinghouse, Church, Kerr & Co., New York.
Electrical Contractors: Western Electric Co., New York.

Northern Electric Company
LIMITED

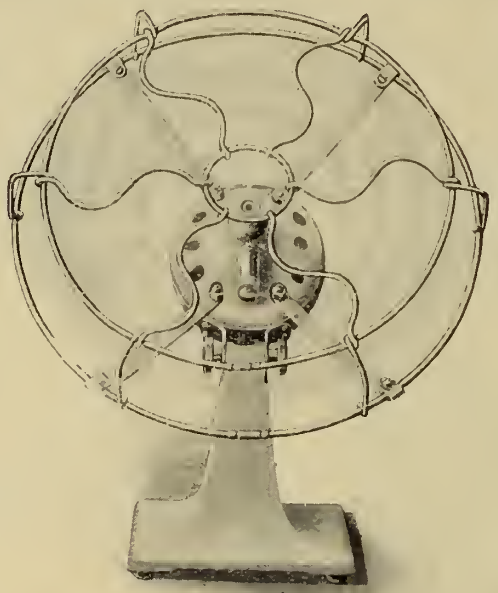
Montreal Halifax Toronto Winnipeg Regina Calgary Edmonton Vancouver Victoria

Successors to IMPERIAL WIRE & CABLE CO., LTD.

Correspondence previously addressed to Imperial Wire and Cable Co. at 611 C.P.R. Building., Toronto, and 902 Electric R. Chambers, Winnipeg, should now be addressed to the Northern Electric Company, Limited, Simcoe St., Toronto, and 599 Henry Ave., Winnipeg.

FANS

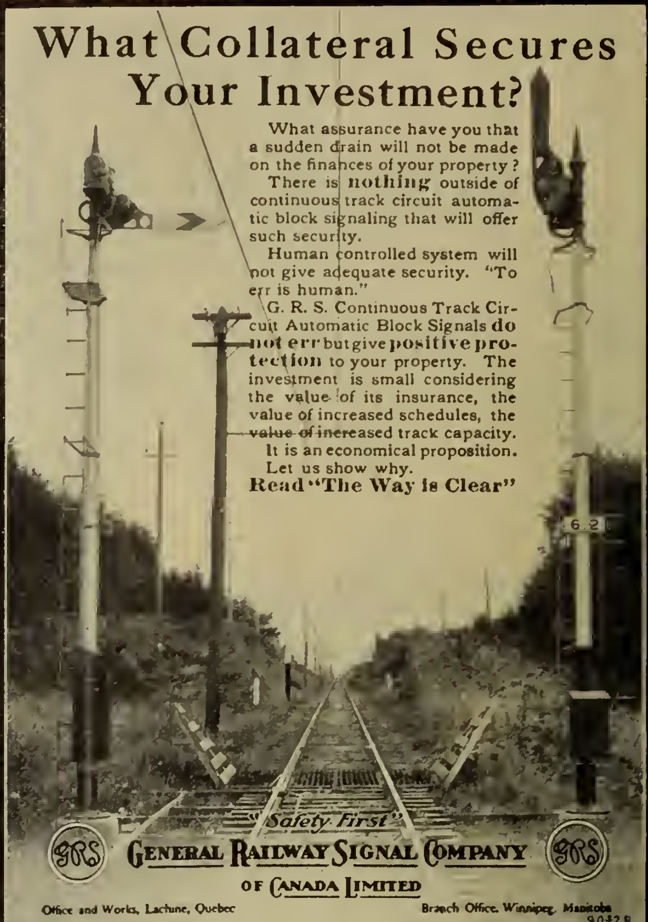
UNIVERSAL MOTORS



If you have not already seen our 1914 Nickle Plated 8 in. Model, write us for Sample.

R. E. T. PRINGLE

New Birks Bldg. Montreal
Tyrrell Bldg. Toronto
150 Princess Street Winnipeg, Man.



What Collateral Secures Your Investment?

What assurance have you that a sudden drain will not be made on the finances of your property?

There is **nothing** outside of continuous track circuit automatic block signaling that will offer such security.

Human controlled system will not give adequate security. "To err is human."

G. R. S. Continuous Track Circuit Automatic Block Signals **do not err** but give **positive protection** to your property. The investment is small considering the value of its insurance, the value of increased schedules, the value of increased track capacity.

It is an economical proposition.

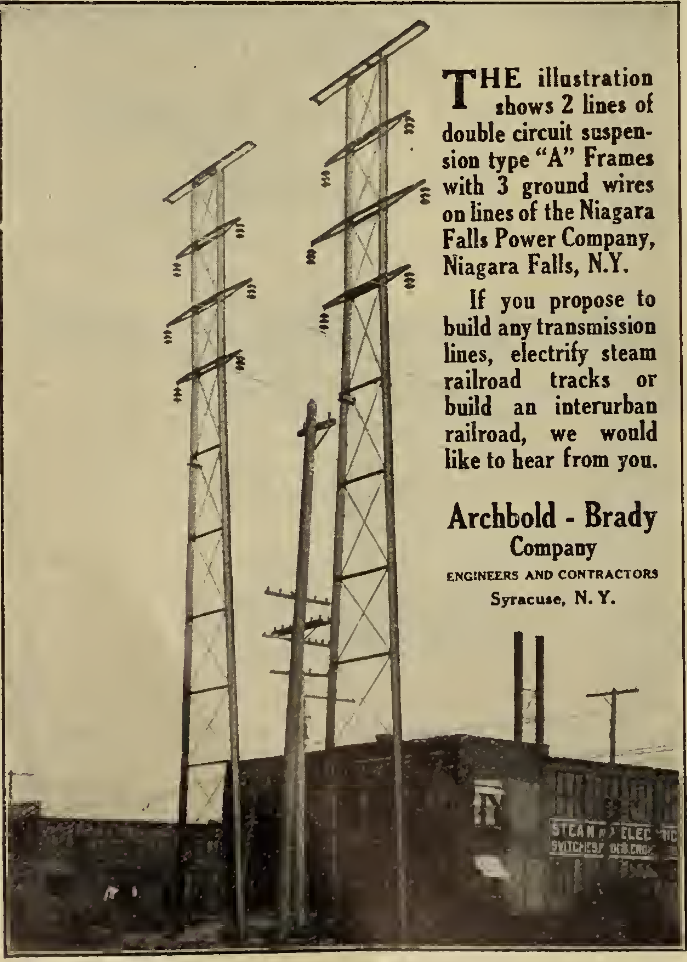
Let us show why.

Read "The Way is Clear"

"Safety First"

GRS GENERAL RAILWAY SIGNAL COMPANY OF CANADA LIMITED GRS

Office and Works, Lachine, Quebec
Branch Office, Winnipeg, Manitoba
9042B.

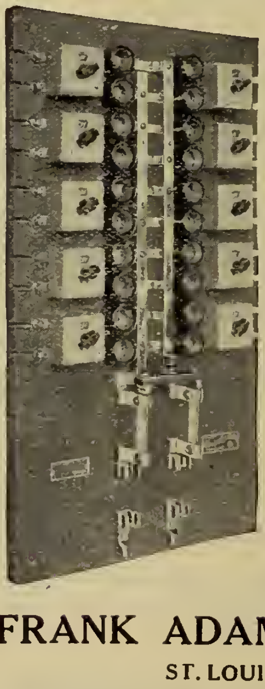


THE illustration shows 2 lines of double circuit suspension type "A" Frames with 3 ground wires on lines of the Niagara Falls Power Company, Niagara Falls, N.Y.

If you propose to build any transmission lines, electrify steam railroad tracks or build an interurban railroad, we would like to hear from you.

Archbold - Brady Company
ENGINEERS AND CONTRACTORS
Syracuse, N. Y.

FA PANEL BOARDS AND STEEL CABINETS

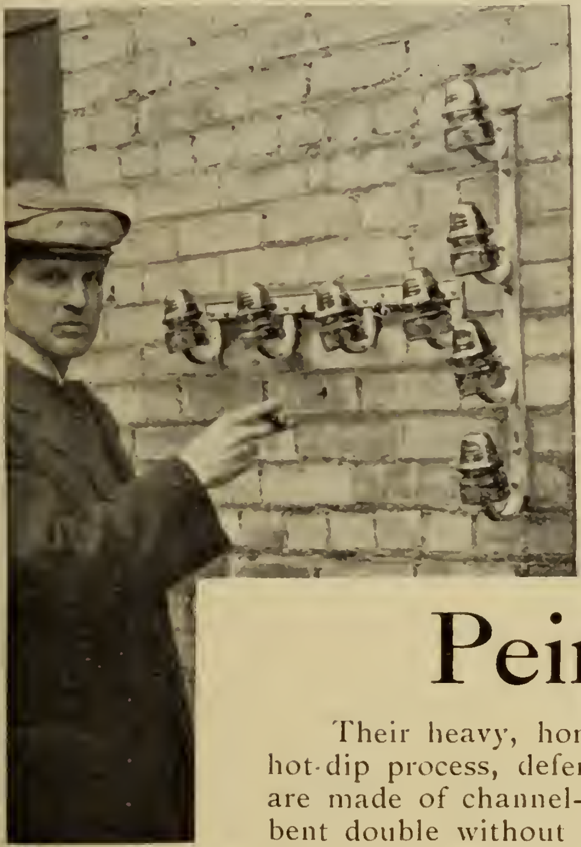


Meter Control Panels and Switchboards are built in Standard and Special Designs for both A.C. and D.C. Light and Power Distribution.

Write for Catalog No. 18

For Special Material Use Our Same-Day-Received Quotation - Service.

FRANK ADAM ELECTRIC CO.
ST. LOUIS, MO., U. S. A.



Your New Construction Will Be Permanent

and will require least maintenance cost, if you make it a fixed practice to use only

Peirce Brackets

Their heavy, homogeneous coating of pure zinc, put on by the hot-dip process, defers corrosion to the dim and distant future. They are made of channel-section, hot-rolled open-hearth steel and can be bent double without fracture. All Peirce Brackets are fitted with

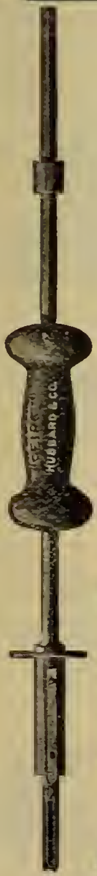
Peirce Spring Threads

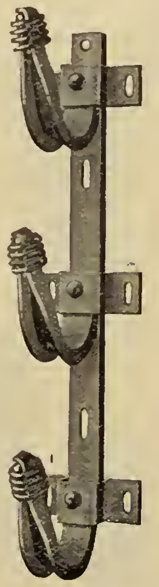
which allow perfectly for expansion, contraction and inequality of bore, yet always hold the insulators securely.

For attaching Peirce Brackets to brick, stone or concrete walls, the "one best bet" is the

Peirce Hammer Drill and Peirce Expansion Bolts

The Peirce Hammer-Drill will drill a hole an inch deep in solid brick in less than a minute. It takes various sizes of drill points, which can be quickly removed for sharpening. Its reverse end is a hollow punch for upsetting the lead sleeves of Peirce Expansion Bolts—it forces the soft lead into every crevice of the brick. When properly installed, Peirce Expansion Bolts will pull off the face of the brick before letting go.

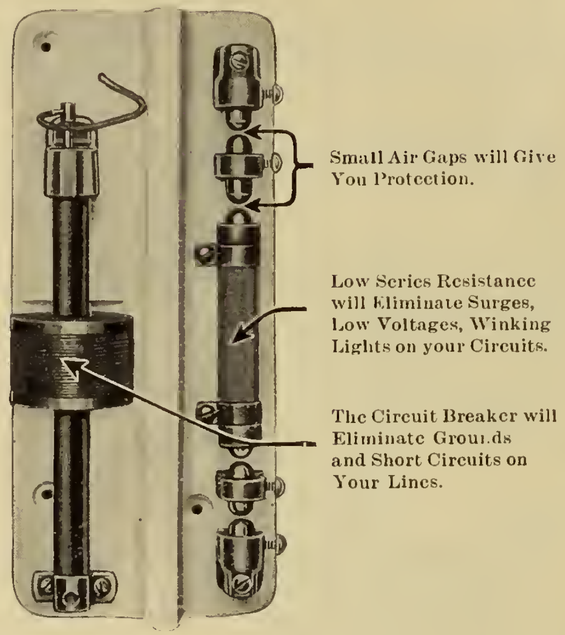




Peirce Specialties and Hubbard Line Hardware are carried by Canadian Electrical Jobbers.

The Hardware MAKES the Line, Hubbard Makes THE Hardware

Hubbard and Company, Pittsburgh, U.S.A.


Small Air Gaps will Give You Protection.
Low Series Resistance will Eliminate Surges, Low Voltages, Winking Lights on your Circuits.
The Circuit Breaker will Eliminate Grounds and Short Circuits on Your Lines.

Are You Safe From Lightning?

Not unless you are using Garton-Daniels Lightning Arresters, because their three distinct features—small air gap distance, low series resistance and a circuit breaker, are essential to insure "complete" protection.

This combination is found only in—

Garton-Daniels Lightning Arresters

which are your only price for safety.

The small air gap distance means sensitiveness and high efficiency in protecting your apparatus. The low series resistance eliminates low voltages, winking lights, surges and other voltage disturbances at the time the arrester discharges.

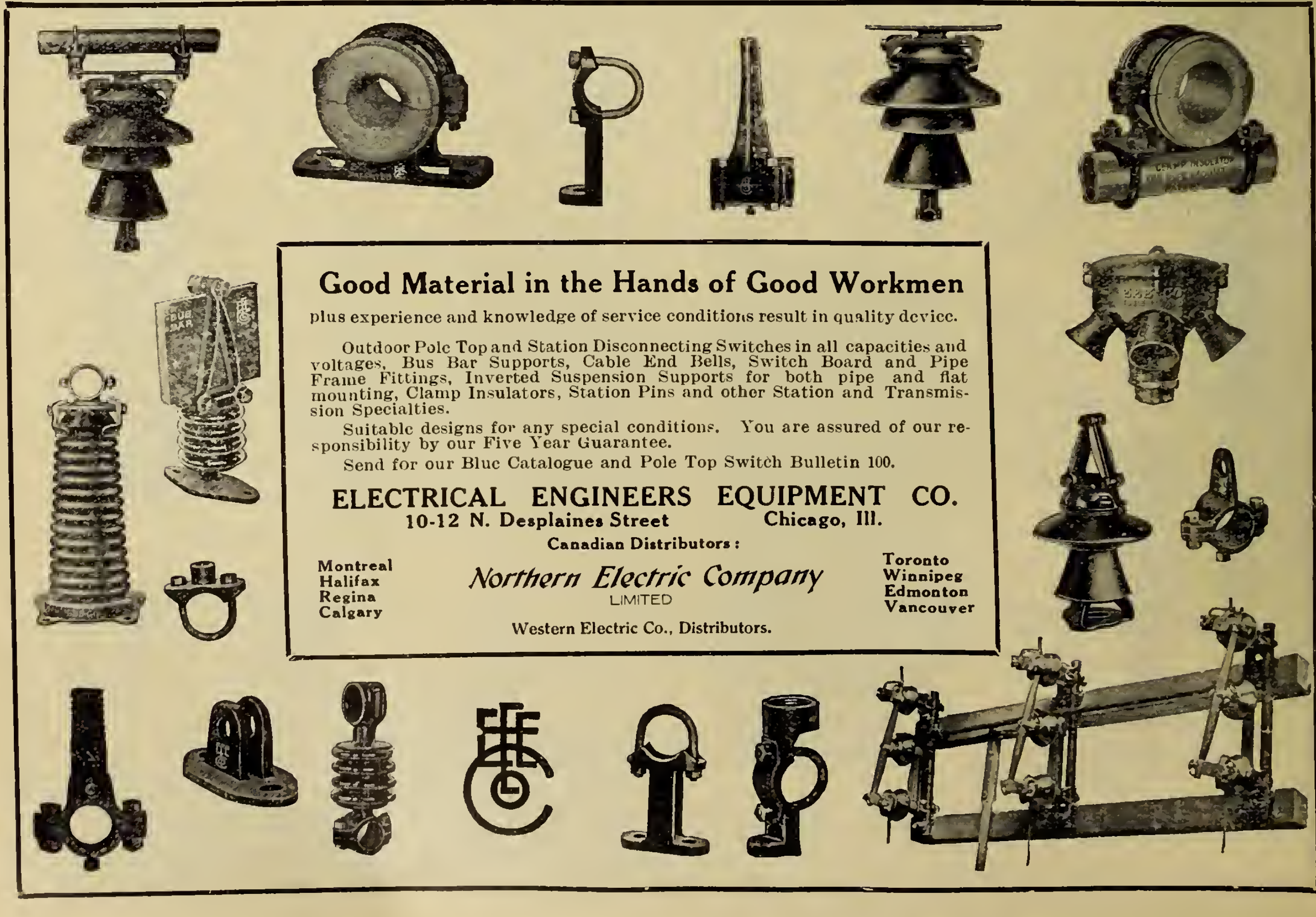
The positive mechanical circuit breaker, in combination with the above, practically elliminates grounds and short circuits through the arrester.

You cannot possibly be safe from lightning without Garton-Daniels Arresters on your lines.

Write for catalogue and quotation to-day.

JOHN MILLEN & SON, LIMITED
Canadian Distributors
TORONTO MONTREAL WINNIPEG VANCOUVER

ELECTRIC SERVICE SUPPLIES CO.
Manufacturers
PHILADELPHIA 17th and Cambria Sts.
NEW YORK Hudson Terminal
CHICAGO 417 So. Dearborn St.



Good Material in the Hands of Good Workmen

plus experience and knowledge of service conditions result in quality device.

Outdoor Pole Top and Station Disconnecting Switches in all capacities and voltages, Bus Bar Supports, Cable End Bells, Switch Board and Pipe Frame Fittings, Inverted Suspension Supports for both pipe and flat mounting, Clamp Insulators, Station Pins and other Station and Transmission Specialties.

Suitable designs for any special conditions. You are assured of our responsibility by our Five Year Guarantee.

Send for our Blue Catalogue and Pole Top Switch Bulletin 100.

ELECTRICAL ENGINEERS EQUIPMENT CO.
10-12 N. Desplaines Street Chicago, Ill.
Canadian Distributors:
Montreal Halifax Regina Calgary
Northern Electric Company
LIMITED
Toronto Winnipeg Edmonton Vancouver
Western Electric Co., Distributors.

Electrical News
Generation, Transmission and Application of Electricity

Published Semi-Monthly By
HUGH C. MacLEAN, LIMITED,
HUGH C. MacLEAN, Winnipeg, President.
THOMAS S. YOUNG, General Manager.

HEAD OFFICE - - 220 King Street West, TORONTO
Telephone A. 929

MONTREAL - Telephone Main 2299 - 119 Board of Trade
WINNIPEG - Telephone Garry 856 - 302 Travellers' Bldg.
VANCOUVER - Tel. Seymour 2013 - Hutchison Block
NEW YORK - Tel. 3108 Beekman - 931 Tribune Building
CHICAGO - Tel. Randolph 6018 - 659 Peoples Gas Bldg.
LONDON, ENG. - - - - - - - - 3 Regent St. S.W.

ADVERTISEMENTS

Orders for advertising should reach the office of publication not later than the 5th and 20th of the month. Changes in advertisements will be made whenever desired, without cost to the advertiser.

SUBSCRIBERS

The "Electrical News" will be mailed to subscribers in Canada and Great Britain, post free, for $2.00 per annum. United States and foreign, $2.50. Remit by currency, registered letter, or postal order payable to Hugh C. MacLean, Limited.

Subscribers are requested to promptly notify the publishers of failure or delay in delivery of paper.

Vol. 23 Toronto, March 15, 1914 No. 6

Power Export Should Stop

In their decision on the application of the Canadian-American Power Corporation to import 46,000 h.p. of electric energy from Canada and distribute it in New York State the Public Service Commission of New York have raised once more that interesting question of the value of the proviso that Canada is allowing power to be exported to the United States only until such time as the Canadian industrial activities shall require its use in Canada. As we have pointed out more than once it is an easy matter to insert such a proviso in an agreement but it is an entirely different matter to enforce the proviso.

The Public Service Commission evidently take it for granted that there is no intention on the part of Canada of ever laying claim to power which is once allowed to be exported into the United States, the exact words of the decision being:—

"We have nothing before us but the suggestion that the Dominion of Canada may at some future time forbid this exportation. This commission must assume that international relations affecting so important a subject as the means of continuing great industries which have grown up in reliance upon the use of this imported power, and as well the interests of the Canadian producing companies themselves, have become fixed and subject only to such changes as will fully protect the great commercial and industrial interests and rights now served by this power brought from Canada. The time has long since passed when governments proceed ruthlessly from pure national rashness or anger to destroy the settled accepted commercial relations and formally vested rights of persons and corporations."

In this decision it is equally evident that they recognize Canada's right to prohibit the export and that they assume the impossibility of enforcing such a condition. Great commercial industries which have been built up in the United States by the use of Canadian electric energy must be protected. It is more than possible this commission does not over estimate the difficulties in the way of Canada's reclaiming power that we have once allowed to slip through our fingers. It is all the more important, therefore, that we should prevent any more exportation. The demand for electric power on the Canadian side has grown beyond the expectation of the most sanguine electric enthusiast and we are already within measurable distance of the time when Niagara Power will be insufficient to supply the needs of Western Ontario. This is a matter of very prime importance to Ontario and Canada as a whole. It seems most unfortunate that at the moment when our enthusiastic Ontario municipalities are preparing to construct hydro-radials throughout the province, the means of operating these radials should be gradually slipping away from us.

Important Resolutions

At a largely attended banquet of delegates of the Hydro-electric Railway Union held in Guelph on February 27, three important resolutions were unanimously adopted. As was pointed out, the treatment accorded private companies in the past should surely be accorded the people of Ontario who want to construct their own roads and it can, no doubt, be taken for granted that the subsidy asked will be forthcoming. The question of power supply is even more important. In something less than three years, a contract limit which was looked upon as sufficient provision for a generation to come, has been practically reached. There is no doubt the electors will back the Government in any move they may make towards the conservation and increased distribution of electric energy for the use of the general public. The resolutions follow:—

1. That they ask the Dominion Government for the usual subsidy of $6,400 a mile for important lines of railway to be built by the Hydro-electric Power Commission of Ontario. Private companies have invariably received such aid and the people's own line should receive the same treatment, resulting in cheaper living and better transportation. Such accommodation wherever supplied has doubled and tripled the value of land.

2. To ask the assistance of the Dominion Government in finding means to greatly increase the amount of power in the Niagara peninsula for the use of the Hydro-electric Power Commission; their power under contract at present being only 100,000 horse-power which will be practically all in use at the end of the year; it being understood there are several methods by which a greatly increased supply of power can be secured, providing the Dominion government is willing to assist in the solution; such power being absolutely necessary to provide for hydro-electric railways and increased consumption in western Ontario.

3. To ask an ocean waterway of 35 feet in depth from Montreal via the St. Lawrence and the lakes to Port Arthur and Fort William, and that the international features of the project be taken up with the United States for the earliest possible solution, it being understood that the improvement of the St. Lawrence will of itself supply eastern Ontario with millions of horse-power of electrical energy, greatly to the benefit of manufacturers, cities and towns and the farming communities with the view that hydro-electric power become universally used for the whole benefit of the people, urban and suburban.

D. C. Railway Electrification

The regular monthly meeting of the Toronto section of the A. I. E. E. was held in the Chemistry & Mining Building of the University of Toronto on Friday evening, March 6. The speaker was Mr. Geo. H. Hill, of the General Electric Company, Schenectady, N.Y., who presented a paper on "High Tension Direct Current Railways." Mr. Hill prefaced his paper by a very interesting picture of the first electric car ever operated. This was in 1879, when the Siemans Company built a very primitive though utilitarian electric passenger car which operated in Berlin.

Mr. Hill's remarks dealt chiefly with the value of electrification on heavy freight terminals, grades and tunnels, all of which were capable of being considered on an economic basis. It was pointed out that safety to human life also rendered the operation of tunnels by electricity an absolute necessity. Regarding the electrification of mountainous sections of country the speaker stated that while a 4 per cent. grade represents the extreme limit of the steam engine, electric locomotives will operate on such a grade and maintain a schedule of 25 miles per hour.

The Butte-Anaconda, the first and only American road as yet operated on 2400 volts d.c., formed the text of a very interesting moving picture illustrated talk on high voltage d.c. electrification. On this road it has been shown that the cost of fuel is approximately 60 per cent. of what it had been under the old system and the total cost of operation is approximately 50 per cent. of what it was with steam.

An interesting phase of the question as discussed by Mr. Hill had reference to the overhead construction. Formerly it was the practice to suspend trolley wires in rigid framework maintaining flexibility only in the collecting device. The present, system, which is giving much better satisfaction, is to make the collector rigid and obtain all possible flexibility in the suspension of the overhead trolley wire. To obtain this the trolley wire is suspended by loops from a wire above, the loops being movable up and down as required to keep the tension constant. One of the most interesting pictures shown was that of a train entering a terminal station with rigid collector which consisted of a metal cylinder five inches in diameter and approximately four feet long passing from one trolley wire to another. The various trolley wires are not connected but are brought, in an approximately parallel direction, to within a few inches of one another. In this way the cylindrical collector may pass from one to the other and may happen to be operated from one-half dozen or more trolleys at the same time, as was shown in this picture. The efficiency of the flexible scheme of suspension of the trolley wire was shown in this illustration also to splendid advantage.

Steam as a Prime Mover

In these days of rapid changes and developments the purchaser of generating equipment is often undecided what type of prime mover is best suited to his individual requirements. This is especially true in the field of the steam engine, where there are now a number of types each, within very fair limits, filling its own little gap in the matter of varying capacities and filling it more cheaply, both as to initial and operating cost, than any of the other types can do. The field of the various types of steam-engine-generator is discussed carefully in a paper by Mr. G. Percy Cole, printed elsewhere in this issue and interesting curves are attached showing the approximate cost of equipment (including electric generators) varying in size from 3 kw. up to 10,000 kw. The paper divides the full scale into four sections somewhat as follows:—(1) Marine type, 3—35 kw. (2) Horizontal reciprocating 35 to 150 kw. (3) Vertical compound reciprocating 100 to 500 kw. and (4) Turbo generators up to 10,000 kw. Units as high as 35,000 in the latter type are now in use. The paper also includes valuable operative cost figures. Inasmuch as Mr. Cole has been intimately in touch with the figures discussed in this paper and speaks with the authority born of recent and close contact we specially commend the article to our readers.

Copper Production in Canada During 1913

A preliminary report on the mineral production of Canada for the year 1913 has just been issued by the Department of Mines. This report was prepared by Mr. John McLeish, B.A., chief of the division of Mineral Resources & Statistics. The production of copper for the year amounted to 76,975,832 pounds, which, at a value of 15.269c per pound, amounted to $11,753,440. Both the quantity produced and the price per pound are slightly less than for 1912, the former figures being 77,832,127 pounds at 16.341c per pound. The price of copper, however, shows a considerable increase over former years as for the four previous years 1908-1911 it ranged between 12.3 and 13.2c per pound.

The Canadian production of copper is represented by the copper contents of smelter products, matte, blister copper. etc., together with the amount of copper contained in ores exported, estimated as recoverable. Quebec province is credited with a production of 3,455,887 pounds as against 3,282,210 pounds in 1912, the increase being due to the increased production from the pyritic ores of the Eastern Townships. Ontario's production in 1913 was 25,884,836 pounds as compared with 22,250,601 pounds in 1912 being mainly derived from the nickel-copper ores of the Sudbury district. British Columbia had an output of 45,791,579 pounds. From the Yukon the Pueblo Mine was the heaviest shipper. The New York price of electrolytic copper varied during the year between 17.45 cents per pound in January and 14.05 in December, the average for the year being 15.269 cents as against an average monthly price of 16.341 cents in 1912. The total imports of copper in 1913 were valued at $7,415,008, divided into crude and manufactured 41,011,961 pounds valued at $6,935,822, other manufactures valued at $371,226, copper sulphate 2,037,714 pounds valued at $107,960. The exports of copper were:fine in ore, matte, etc., 81,879,080 pounds valued at $9,479,480, black in pigs 771,280 pounds valued at $123,431.

New Sub-stations of O. E. R. Co.

Two new sub-stations have just been put into operation by the Ottawa Electric Railway Company, at a cost of $60,000 each. One of these new stations is on Nelson street, near Rideau, designed to supply increased power to the eastern section of the city; the other is on Center street to supply the south-western district. The company now has four such stations in operation, the other two, which were opened some time ago, being at Albert street and Britannia.

The new buildings are fireproof structures, built of brick with concrete roofs, floors and foundations, the dimensions being 32 ft. by 32 ft. and 25 ft. high, well ventilated and lighted. These buildings have three different systems of lighting —by an a.c. supply from the Ottawa Electric Company; by a d.c. supply from the generator, and by a gas lighting system, any one of which may be used in case of trouble on the others. The Rector Automatic gas heating system is installed in both stations.

The motor-generator sets installed in these stations and the switchboards apparatus were all supplied by the Canadian Westinghouse Company. Each of the motors is a 950 h.p., 2-phase, four wire, 2,200 volt, 60-cycle, unit running at 500 r.p.m. at full load. The motors are directly connected to a 650 k.w., 600 volt, d.c., interpole generator. These sets are started up from rest from the d.c. end by a special starting switch and set of grid resistors.

The switchboard for each of the above sets consists of two panels of blue Vermont marble, polished, with bevelled edges, mounted in an angle iron frame supported from the wall by backstays. Mounted on the a.c. panel are an ammeter and wattmeter for each phase, a voltmeter which can be connected to either phase, a polyphase kilowatt-hour meter connected to both phases recording all power used to operate the motor, and one 3,300 volt, 4-pole, 400 ampere, oil switch with overload and no voltage coils.

Mounted on the d.c. panel are one 1,800 ampere, single-pole, automatic circuit breaker fitted with carbon contacts, one 600 volt, d.c. voltmeter, one 1,800 ampere, 600 volt ammeter, one 25 ampere, 600 volt field ammeter, one two-point voltmeter switch, one field rheostat mounting, two 1,200 ampere, 600 volt, single-pole, single throw knife blade contact switches, one five-point motor starting switch used for starting up from the generator end, and the pilot lamps for illuminating the instrument dials.

Behind the board are installed and mounted all instrument transformers, cut outs, fuses, oil switch tanks, field rheostat, field discharge resistance, starting grid resistors, lightning arrester and bus bars.

The power to operate these sets is generated at the company's main power house, provision being made with switching apparatus that in case of emergency they can be connected to any one of the several power houses. The power from the main power house is transmitted by overhead four-wire, two-phase, 2,200 volts, to each of the sub-stations. Between the power lines and sub-stations and all through the sub-stations, paper insulated lead covered cables are used, installed in underground conduit, as well as for the d.c. trolley feeders and rail return circuit.

Electric Equipment in Making Pulp and Paper

The secret of the economical production of cheap pulp and paper is abundant water power capable of economical development, in part at least, into electric energy. The Brompton Pulp & Paper Company has a water power just below Bromptonville on the St. Francis River six miles from Sherbrooke. At first the water power was only used to operate turbines which were direct connected to the grinders, 14 of which were initially installed. Since that time, seven additional grinders have been put in until the capacity is 140 tons per day. The available horse-power is approximately 10,000 for six months in the year. The following electrical equipment situated at East Angus has been installed in connection with this plant:—One 950 kw. generator direct-connected to a pair of turbines of 1,500 h.p. at 214 r.p.m. and one 250 kw. generator direct connected to a pair of 21 in. turbines of 400 h.p. These generators are at mill No. 4. The power is generated at 2,250 volt, single-phase, 30-cycles and transmitted to mill No. 5, the box board mill, where there is a sub-station containing the transformers and distributing switch board. Mill No. 4, or power house, is about one mile from 3-5-6 and saw mill to which the power is transmitted, where the power is distributed to mills No.s 3-5-6 and sawmill.

Mill No. 5, which is all driven by direct connected motors contains one 150 h.p., three 50 h.p., nine 25 h.p., and thirteen 15 h.p. motors; the motors being direct-connected to wet machines, screens and pumps.

Mill No. 3 contains:—one 150 h.p., one 75 h.p., one 50 h.p., six 25 h.p., one 20 h.p., three 15 h.p., and one 10 h.p. These are mostly belted motors.

Mill No. 6 contains:—one 150 h.p., one 75 h.p., one 50 h.p. and two 15 h.p.; these are belted except one 150 and one 50 h.p. which are connected to line shaft with flexible couplings.

The saw mill contains:—one 150 h.p., one 100 h.p., one 15 h.p. The 150 h.p. unit is direct connected to line shaft with flexible couplings; the others are belted.

All motors 50 h.p. and larger are 220 volts and all smaller motors 550 volts. Sub-station at mill No. 5 contains four 150 kw. transformers, 2,250/550 volts for motor circuit and three 10 kw. transformers 2,250/110 for lighting.

The machinery in mills 3-6 and the saw mill is divided into groups so as to require the least possible amount of shafting and belting and so that each group is a department by itself as much as possible. By this means the stoppage of any one department will not interfere with another. The power plant and distribution system were all designed by C. A. Ring, chief engineer, who also designed and superintended the construction of the mills.

Mixed Pressure Turbo-Generator

The Nova Scotia Steel & Coal Company have had in successful operation for some time, a 750 kw. mixed low pressure turbine unit, a view of which is shown in the cut herewith. This set supplies power to the new developments in the collieries, also to a new electric hoist and various motors.

The set has an output of 750 kw. at 80 per cent. power factor, 2200 volts, 3-phase, 60 cycles, speed 3600 r.p.m. A direct coupled overhung type exciter is provided. The stator is fully enclosed in a substantial cast-iron shell provided with a special air inlet and air outlet. The ventilating air is drawn in and expelled by the action of fans attached to the rotor. On entering the generator the air divides into two separate and independent streams, passing through the stator and rotor respectively in a direction parallel to the axis of the shaft. In the stator the air flows through a number of apertures in the body of the stator iron, and also passes immediately next to and along the entire length of each stator conductor. The same method is applied to the rotor coils. By the use of the axial method of ventilation, vent spacers between the core plates are eliminated. Further, as the air feeding the rotor passes through from end to end and does not emerge at intervals to impinge upon the stator, a more quiet running machine is obtained. Lastly, since the air passes axially through the generator, the hottest part of the stator will be that end remote from the cool air supply, and this is accessible to a thermometer.

The rotor consists of a solid steel forging in one with the shaft. In this the slots and ventilating ducts are planned out. Certain slots have air spaces at the sides as well as the base, the cooling of the conductors being most carefully considered. The slots are radial and open, the conductors consisting of copper strip lying flat in the slots and being turned on edge in the overhang. The strip is continuous so that there are no joints in the windings of one coil.

The coils are secured to the slots by means of heavy metal wedges, and in the overhang by means of solid metal winding covers which are shrunk on over an insulating layer of presspahn and registered on machined surfaces at either end. The use of these covers obviates the use of binding wire such as is used on slow speed machines. Moreover, a cover can, in a case of necessity, be quickly and easily removed. Lastly, with axial ventilation, it is unnecessary to cut deep radial grooves in the surface of the forging, so that the stiffening effect of the solid teeth is not impaired throughout their length, in fact, from the point of view of rigidity, the rotor may be said to be "all shaft."

The high pressure steam is supplied to the turbine at 200 lbs. from a battery of Stirling boilers fired by coke oven gases. The turbine also works on mixed pressure low pressure steam supplied from the exhaust of two large vertical engines.

There is also a five-panel switchboard equipped with the necessary oil switches, indicating instruments, disconnecting switches, etc. All the electrical equipment was supplied by the Siemens Company of Canada, the steam turbine being supplied by Fraser & Chalmers of Canada, Limited.

Interesting History

"The History of the B. C. Electric" was the subject of an interesting address delivered recently by Mr. F. R. Glover, general executive assistant, before a large and appreciative gathering in the draughting room of the company's head office at Vancouver. Mr. Glover, whose connection with the company extends over a period of twelve years, and whose knowledge of the subject is thorough, treated his audience to a history of the street railway business on the lower mainland of British Columbia from its earliest infancy to the present day. His opening remarks disclosed the fact that the first electrically-driven street car in Canada was operated by the company in Victoria, that city running its first car early in February, 1889. The first car to be operated in Vancouver was run out of the company's barns on July 1, 1889. Mr. J. W. Paxton, who was present at the address, being the motorman. The original section of line built in Vancouver was from Front Street down Main to Powell, then Carrall to Cordova street, Cambie, Hastings to Granville, then to Drake street, which was at that time the terminus. Several humorous incidents were told by Mr. Glover about the time when the motorman and conductor were one and the same man. He described how the "motorman" had to stop his car while the "conductor" went inside and collected the fares.

Another amusing phase of the company's early tribulations was the fact that in those days the grade on Cambie street between Cordova and Hastings proved an immense obstacle to the running of the cars, the passengers being frequently obliged to alight and push the car round the Hastings street corner!

As an instance of the growth of Vancouver, Mr. Glover quoted the fact that at the time the Robson street branch was opened in 1895 the company awarded free passes to anyone who would undertake to live in that district, many people, prominent to-day, gladly availing themselves of the offer of the free transportation.

In 1890 the New Westminster line came into being, and the interurban line connecting that city and Vancouver was also built. In 1891 owing to the extremely hard times in this country and province, the Vancouver company, finding itself in financial difficulties, offered its business as a going concern to the city for $410,000, but were refused. The offer was repeated in 1893 and 1894 at much reduced figures, the city in each instance refusing to make the deal. Mr. R. N. Horne Payne saved the situation in 1895, by interesting British capital in the concern and through his efforts the Railway Amalgamation Syndicate which was the solid foundation on which the present system was built, and which embraced the Victoria, Vancouver and New Westminster systems, came into existence. The B. C. Electric Railway Company was incorporated in April, 1897, with an initial capital of $250,000, Mr. J. Buntzen being made manager of the concern and Mr. Sperling the electrical expert in charge, the first annual report being presented in July, 1898, to the directors in London, Eng. The first year's receipts of the company were as follows: Victoria, $73,538; New Westminster, $60,947; Vancouver, $52,789.

In 1900 the receipts were $412,368. The capital was then increased in proportion to the increased returns. In 1902 the system of a bonus to employees was decided upon, the amount received by each employee in the first year being $18.20. In 1902 Mr. Glover commenced his connection with the company, which has continued till the present time.

Mr. Sperling was promoted to the position of general manager in 1905, after having worked himself up from a minor position in the eleven years of his service. The progress of the company from year to year was dealt with exhaustively by the lecturer who pointed out that although the concern had always been looked upon as a gold mine by those who did not know the situation, none of the original founders had become rich, and several had died poor through their faith in the future of electric transportation. Mr. Glover paid eloquent tribute to the memory of the pioneers who were not afraid to risk their all for the benefit of the city and province. The capital of the B. C. Electric Railway Company to-day is quoted at $45,000,000, the receipts for the year 1913 being $7,170,523, as against $903,014 in 1905. The number of passengers carried last year was 71,973,822. The business of the company has increased nine times during the nine years since 1904, and the expenses have increased to a corresponding extent.

Merritt Power and Water Plant

By Mr. N. M. Hall, Supervising Engineer

SOON after the incorporation of the city of Merritt, B.C., steps were taken by the new council to add to the rapidly growing city a much needed waterworks system, and at the same time an up-to-date electric plant to replace the small privately-owned system formerly in service. Messrs. DuCane, Dutcher & Company, consulting engineers, of Vancouver and Calgary, were commissioned by the city to look into the situation, and in June, 1912, were able to present a report favorable to the installation of a steam generating and pumping plant, and the necessary electric power and waterworks distributing systems. Generation by steam was recommended on account of the proximity to the extensive coal mines of the city from which fuel was obtainable at a reasonable cost. A gravity water system was not favored due to the excessive cost of pipe lines, but was reported on as a possible future undertaking. The source of water is the Coldwater river, a mountain stream of considerable size, and the pumps were to pump directly into the city system with an overflow tank on an adjacent hill to provide a head of about 25 feet. In July, 1912, the report was accepted, and the necessary money bylaws passed by the city.

The site chosen is on the east bank of the Coldwater River, about 300 feet from the stream. The choice was made in order that the water would be thoroughly filtered in percolating through the gravel bank to the pump well, which is located partly under the power house building. This well is approximately 6 x 10 x 13 ft. deep, and connects by two 8-in. pipes with another well 6 x 20 x 8 ft. deep, located towards the river. Both wells are sheet piled to prevent gravel falling in, and the outer one is arranged with close screens to permit of easy cleaning, see plan herewith.

The building, which is of reinforced concrete with wooden trusses supporting a corrugated iron roof, was erected by Fowler & Larsen, local contractors. An intermediate wall divides the boiler room from the engine and pump-room. In each end is a centrally located double sliding door, and in the boiler room on opposite sides are smaller doors, one near the stack for the removal of ashes, and the other for wheeling in coal from the adjacent coal tracks. A concrete floor in the engine room covers all except the entrance to the wiring and rheostat pit behind the switchboard.

The boilers, stack and feed pumps were supplied by the

Canada Foundry Company of Vancouver. The boilers are return tubular 72 in. x 18 ft. in one battery connected by a circular steel breeching to the 48 in. x 65 ft. steel stack just outside the building. The duplex feed pumps are for use in emergencies only, as the city water pressure will feed the boilers under ordinary conditions. The Griscom Spencer closed feed water heater was supplied by the Chas. C. Moore Company, of Seattle. This type was chosen in preference to the open type on account of the little attention required due to the excellent quality of feed water.

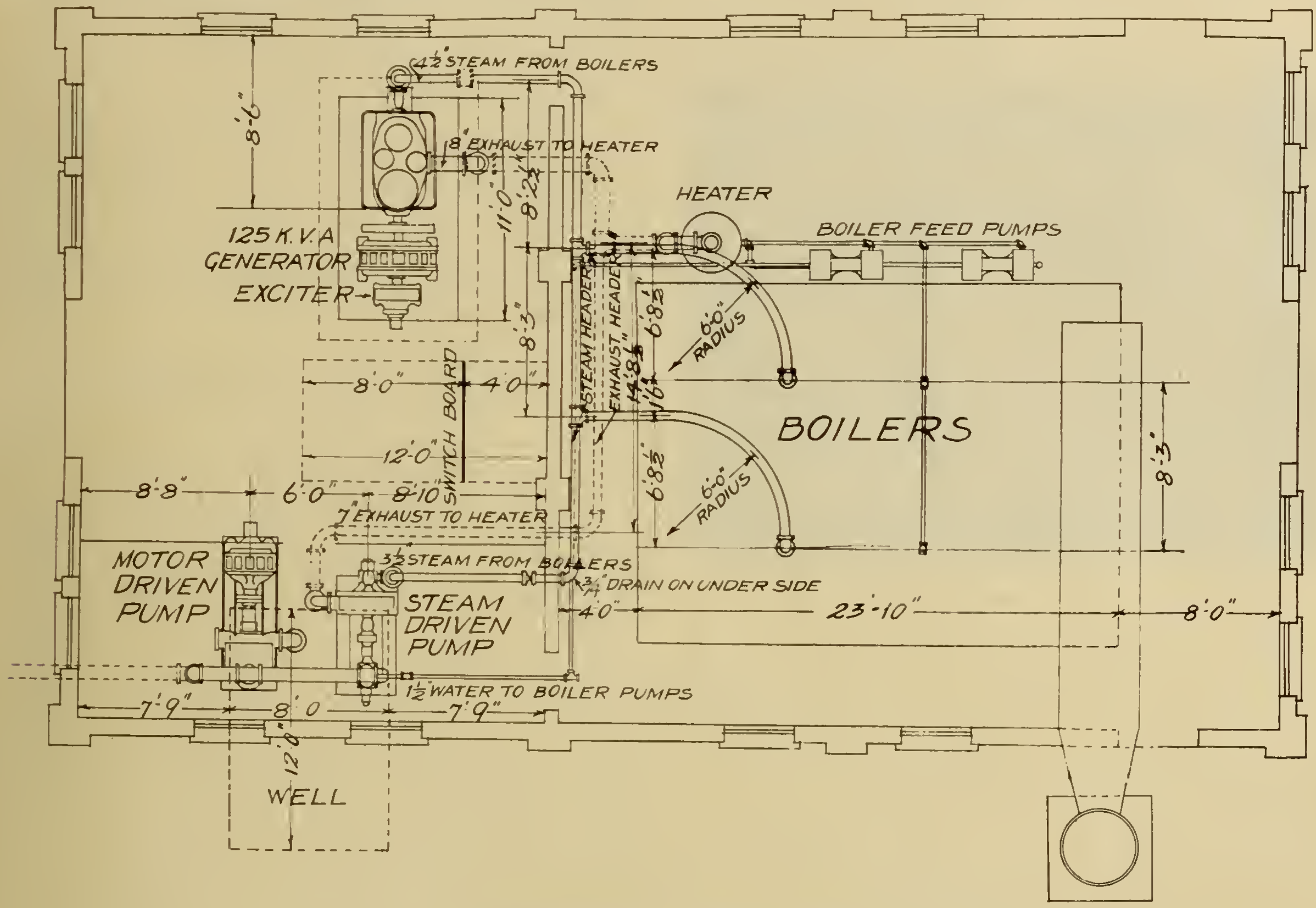


Fig. 1.—Plan of new steam-electric generating plant, Merritt, B.C.

The generator unit consists of a cross-compound, vertical, high-speed, Goldie-McCulloch non-condensing engine direct connected to a Canadian General Electric Company 125 kv.a., 2200 volt, 3-phase, 60 cycle unit, with direct connected exciter. The unit runs at 450 r.p.m., has forced lubrication and sensitive governor, and complete set of gauges and tachometer.

The switchboard and all wiring and conduit installation was supplied by the Canadian General Electric Company. The board, which is of blue Vermont marble, consists of one combined generator and exciter panel and three feeder panels. All wiring is in conduit and all lines lie under the floor, and extend up the wall to the outlet in lead cable in conduit.

The rheostat pit is under the switchboard and suspended from the ceiling are the instrument transformers. The pit is concrete lined and damp-proof. The pumps, which are each of 400 gallon per minute capacity, are located as shown in the accompanying plan, and directly over the suction well. Both were supplied and installed by the Canada Foundry Company. The single stage pump is driven by a Terry non-condensing steam turbine at 2100 r.p.m. and is intended for a standby in case of fire or emergency. The other is a two-stage, 1750 r.p.m. Mather & Platt type and is driven by a Canadian General Electric Company 55 h.p., 2000 volt, wound motor. The secondary grids are located in the rheostat pit, and the controller is shown near and to the rear of the board.

The constant current transformer for the series street lighting circuit was supplied by the Canadian General Electric Company. Included is the control panel with plug switches and lightning arresters. The capacity is 10 kw. and it controls a 40-lamp, 7.5 ampere circuit. At present only one 3-phase circuit leaves the station, and the spare panels are used to control the motor-driven pump and the series circuit respectively. These connections are temporary only,

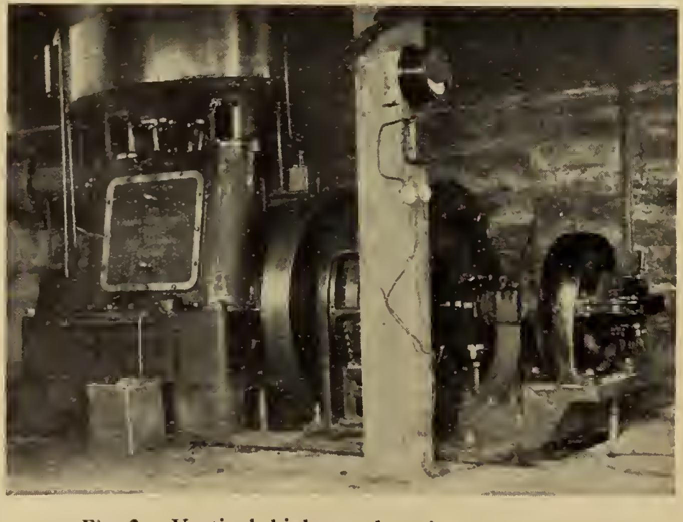


Fig. 2.—Vertical, high speed engine-generator set.

as these panels can at any time be used for additional circuits.

The present overhead distribution consists of a 2200 volt, 3-phase circuit with 110 volt secondaries and a single phase, 2200 volt, series circuit, operating street lamps. The latter circuit is of No. 8 w.p. wire, while No. 6 and No. 8 w.p. are used on the three-phase and secondaries and arranged to give the best voltages. The transformers, including that for the station lighting, are the standard C.G.E. Co. pole type and protected by primary fuse plugs. The street lamps were supplied by the Canadian General Electric Company and are hung from No. 10 messenger wire spanning the street and isolated by two suitable strain insulators. The series lamps are 200 watt and 7.5 ampere.

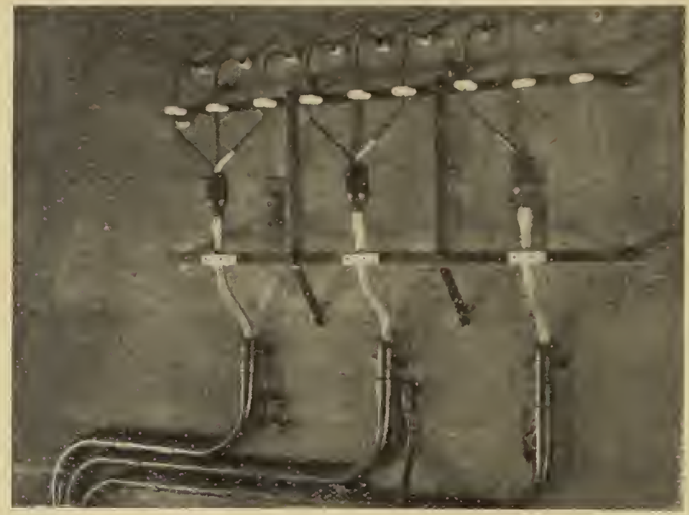


Fig. 3.—Outgoing power lines, Merritt, B.C.

The waterworks system consists of an 8-inch main leading from the pumps to the city system, and thence to the 50,000 gallon reservoir on the hill opposite. The city system consists of a network of 6 in. and 4 in. pipe, fully equipped with isolating valves and hydrants. All pipe used was steel, hub and spigot, and supplied by Robertson, Godson & Company, of Vancouver. The seventeen hydrants were all of the modern Ludlow type.

The wood stave tank was supplied by the Municipal Construction Company, Vancouver. A tell-tale visible from the power house indicates the water level. The overhead wiring was installed by A. B. Kennedy, local electrical contractor, and the machinery, switchboard and connections by the Canadian General Electric Company. The boiler installation and piping, as well as the waterworks system, were put in by day labor.

About March 10th, 1913, the power was turned on in the city, and about the same date the waterworks system was put into commission. A pressure was obtainable at each hydrant of 100 lbs. per square inch, which gives ample fire protection. The water filtering through the natural gravel bed is of good quality and quite free from sediment and scale-forming impurities. The plant, since being put into commission, has run practically without interruption and the city has a plant with ample capacity and reliability to meet the demands of the city and district for at least five years to come. The design and supervision of the work were in charge of DuCane, Dutcher & Company, consulting engineers, Vancouver and Calgary.

The Hydro-electric Power Commission of Ontario have advised the purchase of the plant of the Interurban Electric Company of West Toronto. The price mentioned is $280,000.

Public Service and Public Opinion

By Mr. William McClellan[*]

Every business needs the support of public opinion. Where there is competition, the need is quickly perceived and the support is striven for. Merchants of commodities know another kind of competition, that of disuse. The overcoming of this type of competition they call "creating a market." This is our kind of competition, and we, the public utilities, need the support of public opinion to overcome it. It has taken most of us a long time to realize this, but, with a few exceptions, we recognize it now. Our obtuseness in the past, however, has left us with a sorry burden, for we do not simply lack the support of public opinion but find that that which does exist is adverse to our welfare. We are in the class which the community does not trust, along with the ice man and the watering milkman, and the short-weight coal man. How can we change our condition and get the support of public opinion?

When I consider our circumstances, I am not at all hopeless. I simply try to recognize a problem and then seek the solution. And the problem must be solved if the business is to become entirely satisfactory. Merely dodging an answer never removes a really vital question.

Distrust and consequent regulation did not arise out of vindictiveness. By forgetting or ignoring the force of public opinion, we brought it all upon ourselves. I prefer to think of the public not as wanting to "get us," not as consciously unfair, but as simply insisting on certain rights which have so frequently been denied it in the past. The public must deal with us, and if it prefers to deal through Commissions, there can be no reasonable objection on our part. Fortunately, there is little objection; and education with patience will remove whatever difficulties loom up great at the time.

How shall we gain the much needed support of public opinion? Naturally, it must be gained in such a way that we may keep it. It is the foundation of our business. Unless we build on it, the results may be very disastrous. There are examples enough now to show what is sure to happen in the way of repudiation, virtual confiscation, and even total loss, if public opinion is continually flaunted. There are also examples to prove that in times of stress public opinion is the inner line of fortification which secures a company against annihilation by political and other opportunists.

We may put this differently. Public opinion will support us only on the basis of an enduring confidence. It must have faith in us, which means we must keep faith with it. This involves a sincerity which is not merely a business policy but a state of being. For many of us, it means a complete change of mental attitude, a decided shift of position. Mere promise or protestation will not do. Every action, every statement, every interview, every contract, every negotiation, not only by the chiefs but also by every employee, must be based on a confidence-begetting sincerity. A simple slip, a single case of double-dealing, too much shrewdness, or one attempt to "put something over," can easily undermine a confidence which has been built up by years of effort and thousands of dollars of expense. How shall we start? What are some of the cardinal points?

In the first place, if we have not already done so, we must clean house. We cannot be sincere if we have anything to hide. We ought to know how much property we have, and what it is worth on some basis. We ought to know the cost of doing business, and whether it is as low as our circumstances will permit. We ought to know the condition of our property, and whether it is being handled so as to be continuously in a state of 100 per cent. operating efficiency. We know better than anyone else that rate-making is not a matter of scientific accuracy; but, nevertheless, it should not be a matter of grape-vine growth. We ought, therefore, to make sure that each particular group of rates is internally consistent on some basis. We ought to be able to give some explanation of their peculiar forms. If we are accumulating various funds and accounts, we ought to be able to give an adequate reason for them. We ought to know just what profit we are making, and whether we could square this with public opinion. We have no business to be criminally prosperous.

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[*] Consulting Engineer, New York.

Such a house-cleaning will be dictated by enlightened self-interest. Public regulation ought not to be able to do more than we can do ourselves. In a few cases, it is demagogic; usually, it is prompted by honest intentions but is accomplished in an ignorant and inexperienced manner. Unfortunately, in the past, it has been too frequently found, on the examination of many companies, to be a mess of greater ignorance and planless operation. Information was not available until it was dug out by the regulators. After many a regulation, in spite of some unpalatable orders perhaps, the company has hardly recognized itself in the light of the information given to it by the investigation. Moreover, there are not many examples of ruin caused by regulation.

Provide a Better Plan

Having cleaned house, and with nothing to hide, we ought to be accessible. The prepared-food people have shown us the way. They cleaned house, and then invited the public to come and see how clean it was. Their business is something like ours. Both of us are in a business which the public can do for itself, if it wants to, though in different ways. As a matter of fact, the public went into business with us when it gave us a franchise. We thought it was a free gift, but we were somewhat blind and misled. Again enlightened self-interest would want the public to be acquainted with us. Our officers, therefore, high and low, should be easily accessible. Offices should be arranged so that there is an atmosphere of ease and welcome. The limit of authority of under officials and employees to make adjustments in accordance with well-established principles should be set as wide as possible. Information and explanation should be given with great freedom. The public has the right to understand the basis on which it is paying for service, and it is to our interest that they should. It is easy for a merchant who has one price for a particular article to get the confidence of his patrons. It will be just as easy for us, if we can make our customers understand that we really have one price for each particular kind of service.

Proper relations with, and fair treatment of, our employees are powerful aids to the good-will of the public. It is often forgotten that employees are part of the public, that they live in all sections of our territory, that they are frequently asked questions about this and that feature of our often perplexing methods; and that, therefore, they have much opportunity to mold public opinion. The sincerity of the company can be impressed on them in several ways, not with the idea of buying their loyalty and good-will but of inducing these valuable assets. They should never be asked to do anything which could not be justified publicly if necessary. They should understand that nothing is going on in any part of the company that need be concealed, and that their own work is to be carried on in the same manner. They should be taught the ideals of the company, and that they are expected to have a large part in the realization of these ideals. All questions of hours, remuneration, and other working conditions should be open for discussion at any time between the persons involved. Whatever the outcome, it should be capable of explanation from the standpoint of the business as a whole. They should be dignified by being treated as freely contracting parties with the company, and not as a species of valuable beast of burden which must be controlled and cared for. A certain amount of welfare work is desirable, insofar as it does not replace a proper increase in remuneration. This question of the employee has received too much attention of one kind and not enough of the right kind. They are our outposts in the public and have tremendous force in specific cases and in general influence.

A constructive policy in relation to social and community progress is essential in gaining public opinion. I believe that a public service company is the most important factor in the development of a community. To believe this and act accordingly is to realize the responsibility of our franchises. Have you ever thought about this "free gift" of franchises? The community wanted to give them to us and hoped that we would take them. They thought that we were going to make a lot of money through them; but that was not the reason that we got them. The community also expected to benefit greatly from the gift. Therefore, in proportion as it benefits, so will we gain their good opinion. This means adequate and satisfactory service, and extension of lines promptly so as to aid the growth of the community in area and development. Under such a policy, I believe rates will adjust themselves on account of the enlightened self-interest of the company. High rates and largest profits seldom go together.

This constructive policy will show itself in some broader phases of community life. Legislation of various kinds will not be opposed unless it is inherently wrong. When opposition is necessary, it will be done publicly; and in the hope of enlisting the intelligent sympathy of the community. The company, regarding itself as a good citizen, will be in active sympathy with all uplift movements, such as hospitals, and safety plans for the public and its employees. It will contribute from its funds, but especially by its knowledge and intelligent effort, so far as sound business and social policy will permit. The presentation of a pulmotor to a hospital, or of expenses to an injured employee are good actions in themselves. How they will affect public opinion depends upon whether or not the actions flow from a consistent business policy.

Be Accessible to the Public

In our own state, perhaps the most shining example of a lack of constructive policy is shown by our treatment of the conservation of water power. Public opinion regards the water powers of the state as great and valuable resources. Attempts are made to develop these resources and the public service companies of the state are found in opposition. There is some indication that this opposition is organized in the sense that it proceeds from national and state committees representing the companies. In the resentment which is called forth, it is not perceived by public opinion that the opposition is almost entirely against the method and not against the principle. This must be charged, however, to the lack of constructive effort on our part. Surely as business men, we know that the easiest method to beat a bad scheme is to provide a good one. In times past, when public opinion was quite inattentive to such matters, other methods were available, but not now. Opposition to such projects as these has a far reaching influence in our local business relations. Why should not the public service men of this state stand out in the broad light and acknowledge that the state has valuable water powers which could be developed? Why should these men not offer their wide experience in devising proper plans by which the developments could be made so as to give the state as a whole the benefits and profits to which it is justly entitled, and, at the same time, protect investments of all kinds already made? Why should not a bill be offered which the public service men could work for openly, in the light of day? I know that there would be much misunderstanding by the public. They have never been accustomed to seeing us play such a part. But, if it is right, we ought to have the courage to attempt it. A dozen public service men, known in as many communities as men of probity, ability and experience, standing as directors of a campaign of education, going directly to the public of their own communities, hiding nothing, using no subterfuges, might have a long pull to the finish, but would discount failure at the start. And the collateral benefits from such a campaign would be very great. Public opinion is now active and thinking about our affairs. We must reckon with it; or, finally, lose out.

Advertising, I have put last where I think it should be. After we have done everything else which is necessary, we can talk about it. I believe in advertising and plenty of it. This is not the place to discuss methods, where there are so many. As a matter of fact, everything that we do should be advertising, that is, turning the people to us. Advertising which is mere protestation or exaggerated promise is ruinous, in the end; and is likely to result in nothing but a cynical smile. Simplicity, truthfulness, and sincerity count here as elsewhere.

After all, does not our whole argument mean that we must take the public into a real partnership? In a peculiar sense, they have been contributors to our enterprise. A franchise is a necessity in order to have a public service business and yet there has been little disposition to allow a company to value it. May this not be regarded as the equity of the public in the business? Are not all the attempts made by the public to regulate our business to be regarded as an attempt to assert this partnership? May it not be that its very obstinacy arises from our past stubbornness in regarding our business as entirely private, to be operated as we saw fit. The total disregard by the public, in the past, of its interest in our business is as much responsible for the present condition as our misunderstanding of the relations which should exist. While the change is taking place, there is great danger that the dominance of capital will be exchanged for the dominance of the public. Both are bad, because they are both naturally self-seeking. The hope of a proper balance is in the operating man, from President to common laborer. His part is to teach each of his partners to respect the rights of the other. The "Company" can no longer be synonymous with "Capital" but must mean the three-strand partnership of capital, labor and the public.

Hamilton Section C. E. A.

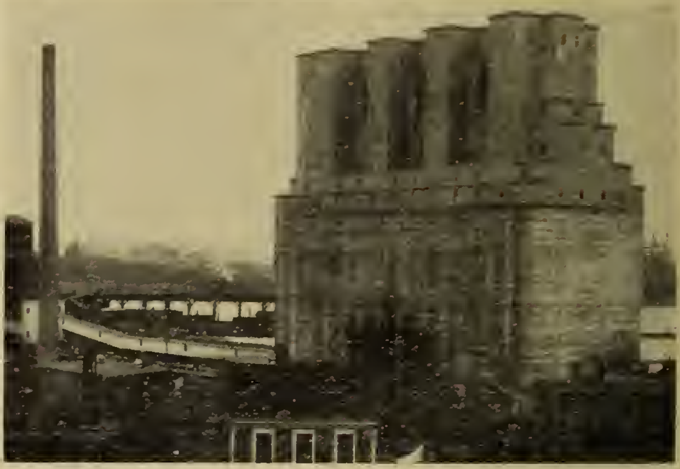
The Hamilton section of the Canadian Electrical Association held its February meeting on the evening of Thursday, February 26, with a large attendance of members. The special feature of the evening was a lecture on "The Ozark Water & Power Company's Development on the White River," written by Mr. T. O. Kennedy and presented by Mr. N. S. Cumming. The lighter side of the programme consisted of a number of musical items and an interesting travel talk by Mr. Coleman, general manager of the Dominion Power & Transmission Company, consisting of a description of a fishing trip in the north country. Mr. J. H. Larmonth, secretary-treasurer of the Canadian Electrical Association was present and addressed the meeting on association work.

Provision is made in this year's expenditure on the Montreal harbour for the electrification of the railway system. The cost is put at $282,674, with $300,000 for equipment. This year the electrification will be pushed as far as possible, and the actual trackage extended to Pointe aux Trembles. The ultimate terminus of the railway system is Bout de l'Ile, which it is expected will be reached next year. On the south shore, where the commissioners will carry out extensive improvements, eight miles of electric railway will be laid down.

C. P. R. New Terminal Elevator

When navigation closes on the St. Lawrence river in the fall, the railways have to haul grain for winter export to one of the winter ports, where cold weather cannot stop the necessary work. The new terminal elevator shown in the accompanying illustration has just been completed and put into operation at West St. John, N.B., the winter port of the Canadian Pacific Railway.

The elevator is 92 ft. 7 in. wide by 195 ft. 7 in. long and the roof of the cupola is 202 feet above the tracks in the elevator first storey. The bins are of reinforced concrete resting on a heavy girder and slab foundation of the same material. The principal bins, of which there are 77, are circular or elliptical in shape and are 84 feet deep averaging a capacity of 11,000 bushels each. The 94 resulting or interspace bins hold an average of 2,000 bushels each. This makes 171 bins, with a total figured capacity of 1,035,000 bushels. The cupola is built of structural steel and is 93 feet high, comprising five storeys for weighing and distributing grain. The steel frame is covered with galvanized corrugated iron. Floors and roofs are reinforced concrete; roofing is 5-ply Barrett specification tarred felt and gravel; windows are wire glass.



New C.P.R. elevator—Power house seen to left.

Electrical energy is used throughout; elevator legs, separators, dust collectors, conveyors, passenger elevator, car puller and car shovels being driven by individual motors. There are four tracks running lengthwise through the elevator, serving eight elevator legs of 12,000 bushels hourly capacity each, all of which are driven by individual 75 h.p. motors. Rope drives are used, and a clutch on the countershaft enables the motor to start without load. The elevator legs deliver grain to eight 2,000 bushel garners, below which are eight 2,000 bushel hopper scales. From these scales the grain is distributed to the bins, two motor driven conveyors on the floor beneath the scales giving great flexibility to the system of distribution. By installing reversing switches on the motor leads, these conveyors may be run in either direction. Although this elevator is not specially a grain cleaning house, it is provided with two large separators, driven by individual 15 h.p. motors, to handle such work as may prove necessary. The passenger elevator is driven by a squirrel cage induction motor. It is considered inadvisable to use any other type of motor for grain handling as the smallest electrical spark is sufficient to set fire to the grain dust, which penetrates to all parts of the elevator.

On the ground floor a 75 h.p. motor operates two car pullers, by rope drives. Each car puller has two winding drums with heavy steel cable, designed to move fifteen to twenty loaded cars. The car shovels are operated from two line shafts, each driven by a 35 h.p. motor. It is anticipated that the time will come when most of the grain will be carried in cars so constructed that the entire load may be dropped into the hopper below the track without the use of car shovels.

For shipping grain, there are two 36-in. conveyors loading through an elevated gallery to the old C. P. R. elevators and thence to all the vessel berths on the Sand Point Basin.

The power house is a brick building 38 ft. wide by 80 ft. long and 25 ft. high. The equipment consists of four horizontal return tubular boilers 72 in. x 16 ft., carrying a working steam pressure of 150 pounds; two Allis-Chalmers turbo-generators of 500 kw. each, operating in connection with a Worthington barometric condenser; a 10 kw. lighting set, together with feed water heater, pumps, etc. The smoke stack is of reinforced concrete, 6 ft. inside diameter by 202 ft. high, see figure herewith.

The turbines run at 3600 r.p.m. and generate 3-phase, 60-cycle, 550-volt current, which is fed directly to the motors. A motor driven vertical, centrifugal pump supplies sea water for condensing purposes through over 1000 feet of piping. Under ordinary conditions lighting current will be supplied from a 550/110 volt transformer; as an alternative or when the turbines are not running. the lighting set may be used. The switchboard is so arranged that the two generators may be operated in parallel; and the two exciters, which are mounted on extensions of the generator shafts, may also be paralleled on direct current bus-bars. A Tirril regulator maintains constant voltage on the main bus-bars at all times.

The wiring from the power house to the elevator is carried overhead in a single span about 30 feet clear of the tracks, and supported from steel frameworks on the power house roof and on the walls of the elevator. Throughout the elevator and power house all wiring is installed in conduit. The conduit is fastened rigidly to the concrete walls. Heavy iron straps and expansion bolts are used to prevent any possibility of the conduit becoming loosened, due to corrosion, and to make the installation as permanent as possible. Feeders are run to the different floors where power panels, with branch fused circuits for the individual motors. are installed.

The motors are fused for about 250 per cent. of their rated capacity; amply large to allow for starting up, even under load. Motors are installed with liberal power for the work to be performed and to meet all overload demands. The fuses are not designed to, and indeed do not, protect the motors against overload, but merely operate in case of an accident. The importance of avoiding a shut-down is responsible for this method of fusing. Motors protected thus have been used extensively for grain handling, and where properly designed and proportioned for the load, give thorough satisfaction.

An intercommunicating telephone system connects the various floors and offices in the elevator and with the power house. The telephone cable is lead covered and installed in conduit, experience showing that this is the only satisfactory method of installation. Electric signals are used to facilitate handling grain inside the house and for the passenger elevator.

Throughout, the electrical work is of exceptional ruggedness of design, and this applies to motors and panel boxes, as well as to the wiring. Dust, dampness and the importance of maintaining continuity of service, all combine to bring about problems which can only be solved by using apparatus with more than the ordinary factor of safety.

The turbo generators were furnished by the Allis-Chalmers Manufacturing Company, of Milwaukee; induction motors by the Canadian General Electric Company, and the Canadian Allis-Chalmers, Limited. The Northern Electric & Manufacturing Company supplied the switchboard. The electrical installation, including all wiring and erecting the switchboard was carried out by W. J. O'Leary & Company, of Montreal. The constructing engineers of the entire plant were the John S. Metcalf Company, Limited, of Montreal and Chicago, acting under the direction of J. M. R. Fairbairn, assistant chief engineer of the Canadian Pacific Railway Company.

Personal

Mr. W. T. Woodroofe, superintendent for the past two years of the municipal street railway system of Edmonton, Alta., has resigned.

M. Thomas Ahearn and Mr. James D. Fraser, president and secretary-treasurer respectively of the Ottawa Electric Railway are spending a few weeks' holiday in Florida.

Mr. P. T. Davies, of the Montreal Light, Heat and Power Company, has been appointed alternate statesman for the Province of Quebec of the Jovian Order. The Montreal members are holding a weekly series of dinners, lectures, and entertainments at the Commercial Travellers' Club.

Mr. Frank Ahearn, a director of the Ottawa Electric Railway, and son of Mr. Thomas Ahearn, president of the O. E. R., has been approached by a number of his friends to accept the liberal nomination for West Ottawa and contest it with Mr. J. A. Ellis, M.L.A., in the next provincial election. Mr. Ahearn says he is not yet prepared to say whether he will yield to the importunities of his friends in the matter. Mr. Ahearn, with his wife, is now spending a two months' vacation in Europe.

Mr. J. H. Larmonth.

Mr. J. H. Larmonth has been appointed manager of the Edmonton Municipal Electric Railway System, succeeding Mr. W. T. Woodroofe, resigned. Mr. Larmonth has had a varied and valuable experience in electric and electric railway work. For many years he was manager of the Peterborough Radial Railway Company during the construction period of this company. Later he was also manager of the Peterborough Light & Power Company. When these two companies were taken over by the larger Electric Power Company, Mr. Larmonth became general manager of the latter. Some two years ago he resigned this position to take up private consulting work in Toronto, and a few months ago he was induced to accept the secretaryship of the Canadian Electrical Association, which latter position he has held up to the present time. Mr. Larmonth therefore brings to his new work an experience which augurs well for the success of the western city's railway system.

Will Manufacture Steel Lamp Posts

The Canadian Union Metal Manufacturing Company, recently incorporated, have commenced manufacturing pressed steel posts, etc., in the Edwards foundry at Galt, Ont. The company will build a new factory 60 ft. x 300 ft., one floor, during the present year. When completed the factory will turn out all sorts of pressed steel columns for verandahs, interiors, etc., including lighting standards for street work.

Organization of a Stores Department

An article dealing with its organization, management and records, also showing some of the forms used by the Toronto Electric Light Company, and storage shelving and racks of Buick Motor Company, of Boston, Mass., and Union Street Railway Company, New Bedford, Mass.

By Mr. W. G. Astle, Storekeeper Toronto Electric Light Company

The Stores or Stock Department of any business is that section which has the custody of its stock-in-trade, materials, supplies, and other physical property, except real estate. This department when scientifically organized and managed becomes one of the most valuable from a profit-making standpoint, but, without the proper organization and management it may degenerate into one of the most useless. The organization and system must be of the very best to attain the state of efficiency of which it is capable, and like every other department of a business, the organization depends largely upon the nature of the business.

What is Material?

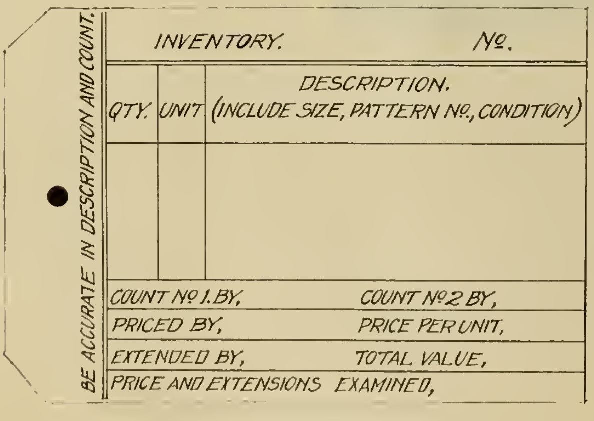
Material is the first great factor in the cost of a thing to the producer, and may be classified as Raw Material, Finished Commodity, and Accessory Material.

Raw Material may be defined as any material for use in process before it has been subjected to that process. Finished Commodity designates any industrial product which is introduced, without substantial charge, into the composition of another product, usually as an accessory part. Accessary Material is material necessary to a process, yet not actually entering into the completed product, and is commonly considered a part of general manufacturing expense, particularly if the material is used again and again, and not directly chargeable against any one particular job.

Two Types of Organization

The aim of any organization should be: To systematically unite each individual into a body purposed to work together for one common end; to unite in reciprocal and concrete relation and duties; and, to bring into systematic connection and co-operation parts of a whole. This is the first necessity of any organization, either commercial or industrial.

The elements of any organization are men, equipment, and space. You have an efficient organization when the elements are combined in such a manner that they will operate harmoniously, accurately and promptly, and will achieve the result required with the least expenditure of money and effort.



BE ACCURATE IN DESCRIPTION AND COUNT.

INVENTORY. No.

QTY.	UNIT	DESCRIPTION. (INCLUDE SIZE, PATTERN No., CONDITION)

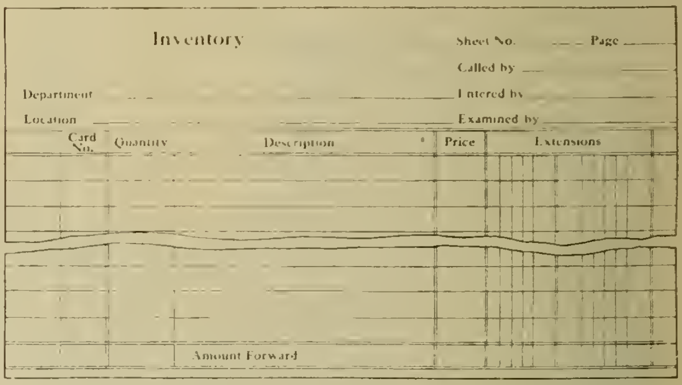
COUNT No 1. BY, COUNT No 2 BY,
PRICED BY, PRICE PER UNIT,
EXTENDED BY, TOTAL VALUE,
PRICE AND EXTENSIONS EXAMINED,

Fig. 1—Inventory cards.

Organization can be divided into two kinds, military and functional.

Functional organization is a type of organization that gives each worker, whether executive or clerk, as few functions as possible to perform. Major Charles De Lano Hine, in his book "Modern Organization," describes the unit system of organization employed on the Union Pacific Railway, which is a type of functional organization peculiarly adaptable to the railway business by reason of its scattered forces.

Military organization is a type of organization where one man has supreme authority over a branch of the company's work. Mr. F. W. Taylor, in his book "Shop Management," points out that this type of organization is inefficient, because if the man's duties were properly fulfilled, he would actually be an expert in many branches of business knowledge. The foreman who hires and fires, plans the work, supervises the cost accounting system and has charge of new construction, operates under this plan.



Inventory Sheet No. Page
Called by
Department Entered by
Location Examined by

Card No.	Quantity	Description	Price	Extensions
		Amount Forward		

Fig. 2—Inventory record taken from cards, Fig. 1.

The organization of a storeroom, however, will have to be modeled according to the conditions found in the individual establishment.

Scientific Management as Applied to a Storeroom

Scientific management has passed the stage of experiment and has firmly established itself in many of the greatest industries. Men have been slow to grasp the significance and tremendous possibilities of the scientific means of doing work in all branches, but the survival for over thirty years of a movement of this character through all the opposition, objections and difficulty strewn in the path of any innovation gives trustworthy evidence of the soundness of the ideas and a fair prophecy of their extensive application in the near future.

The physical aspects of a storeroom under this style of management do not differ very much from any well systematized storeroom. A proper means of storing and piling the material, laid out in an orderly fashion should be provided. To avoid confusion in a varied terminology, mono-meaning symbols should be used to designate the different kinds of material. The maximum and minimum should be determined for each kind and kept on the stock ledger sheets or cards. The location of the materials should also be indicated on these sheets or cards.

Under this style of management it is not enough, when material is required, to send a requisition to the Stores Department, but all orders for work that require material should have the items booked up and assigned to the specific orders by the Storekeeper, and this material, when assigned to a given order, should not be available for any other orders whish may follow. This should be done before the material is required for use and will serve as an advance notice to the Storekeeper should any unexpected demand for a particular material occur.

The work of moving materials into the storeroom and moving them to the particular place where they are to be used, becomes a function of the planning of the work, and of the routing of the work, and the man who is to use them should not be delayed or have to give a thought to the materials which he needs for his next job. They should be moved in the right condition for his use to the point where he can use them to best advantage. The time which the man spends looking or waiting for his material can be better spent in effective work.

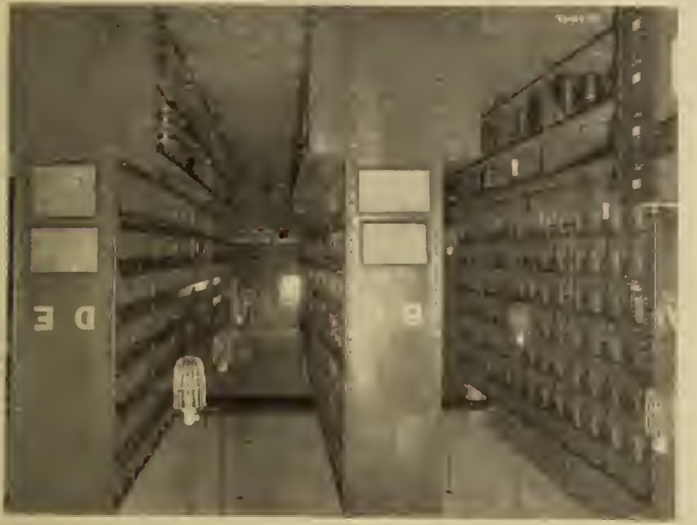


Fig. 3—Storage adjustable shelving.

Inventories

Before a system of stock records can be successfully installed, a complete inventory must be taken, and from this is formed the basis on which the records are founded. When once this inventory is taken and properly recorded, it is possible to install and maintain a system which will make it unnecessary to take an inventory of all the materials at any one time. The chief requirements of an inventory are exactness in description, enumeration, and appraisal.

Several gangs of men working together in different parts of a storeroom make it impracticable to take a consecutive list of the materials on hand, therefore it appears best to make the original records on cards, one for each lot of similar items. These cards, Fig. 1, should be numbered consecutively, and should be provided with a hole punched at the centre near the top, for attaching a string, as with the ordinary shipping tags.

Before beginning an inventory all the men should be called together and given instructions in the methods to be followed, and foremen should be selected for the various gangs and assigned to the materials with which they are the most familiar. They should also be instructed to commence at a suitable point and progress regularly. The foreman of each gang will then record the data for each lot on the cards, and check the count of his helpers, after which he will attach the card to the material. This procedure is followed until every different article in the storeroom is tagged. This is only a preliminary count and the work in the storeroom should not be interrupted to any great extent. The man who takes out any material should change the tally memorandum on the card for any lot of material already counted.

On the date decided upon for the inventory, the work should be changed around so that a different force of men will go over the work done by the gangs in the first round. This second gang will take off the cards attached to each lot, verify the condition and number, and proceed as rapidly as possible. It should not be necessary for this second gang to check every piece of material, but only to test occasional places at random, or to satisfy themselves in some way that the cards give an accurate record of the material they represent. When these cards are all checked and removed, they should then be sorted numerically to make certain that they are all accounted for, after which they can be arranged in any way that will simplify the operation of pricing. After they have all been priced, checked, and arranged in whatever way desired, the inventory can then be typewritten on loose-leaf sheets, Fig. 2, and bound for future reference.

Perpetual Inventory Plan

The old custom of making inventories but once a year is fast becoming obsolete, due to the fact that under that system little opportunity is given to trace losses in any department, and to the difficulty of going over the entire amount on hand at any one time. A better arrangement, and one which commends itself to the practice of to-day is commonly called a perpetual inventory. To adopt such a plan, it must be first ascertained the number of kinds of material in stock, and a schedule arranged whereby a certain number of items are counted each day during the year, and compared with the stock sheets or cards; if necessary they should be immediately readjusted. The result of this method will be that no extra effort will be required, and the work can be done by the storeroom staff, who are thoroughly familiar with the different materials handled almost daily in filling orders.

There is no real reason why an actual inventory should be required at any one time. If the Storekeeper has a check, from time to time, of the actual stock on hand to compare with his stock records, it is just as practical as though all his information was supplied to him at one time. On the other hand, this plan has many advantages in that it does not interfere with the routine filling of orders, it does not require the employment of additional help in the storeroom who are not familiar with the material in stock. In actual operation, the above plan is not only feasible, but it has proved most desirable from an efficiency and economy standpoint.

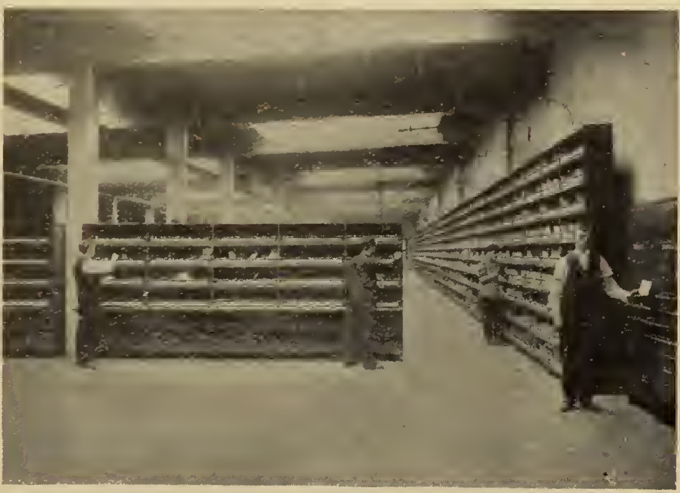
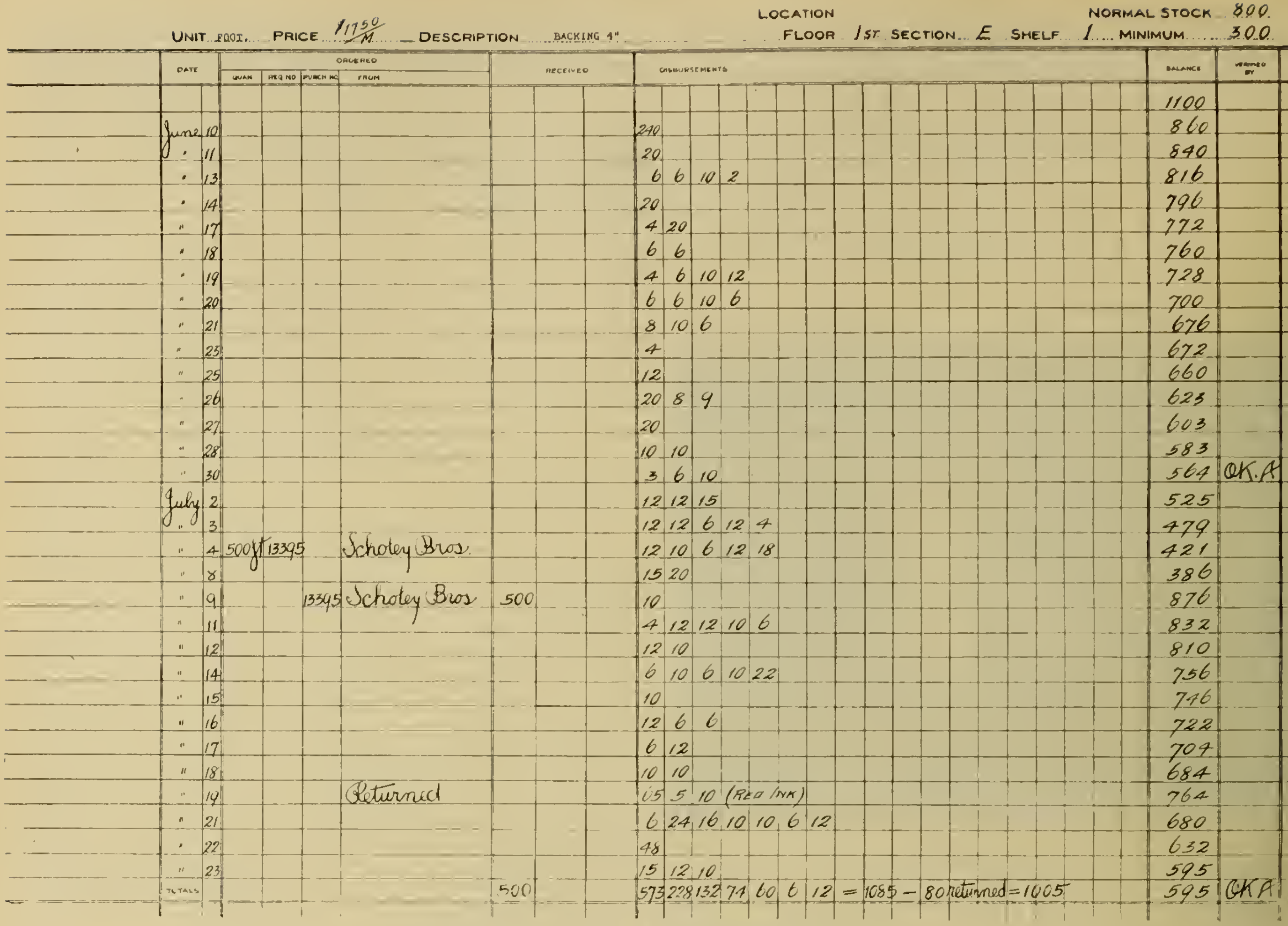


Fig. 4—Storage adjustable shelving.

Storage, Shelving and Racks

This is one of the most important points to be dealt with when installing an up-to-date storeroom system, and very often there is not enough importance attached to this feature



UNIT FOOT. PRICE $1750/M DESCRIPTION BACKING 4"

LOCATION FLOOR 1st SECTION E SHELF 1

NORMAL STOCK 800. MINIMUM 300.

	Date		Ordered				Received	Disbursements								Balance	Verified By
			Quan	Req No	Purch No	From											
																1100	
	June	10						240								860	
	"	11						20								840	
	"	13						6	6	10	2					816	
	"	14						20								796	
	"	17						4	20							772	
	"	18						6	6							760	
	"	19						4	6	10	12					728	
	"	20						6	6	10	6					700	
	"	21						8	10	6						676	
	"	23						4								672	
	"	25						12								660	
	"	26						20	8	9						623	
	"	27						20								603	
	"	28						10	10							583	
	"	30						3	6	10						564	OK.A
	July	2						12	12	15						525	
	"	3						12	12	6	12	4				479	
	"	4	500 ft	13395		Scholey Bros.		12	10	6	12	18				421	
	"	8						15	20							386	
	"	9			13395	Scholey Bros	500	10								876	
	"	11						4	12	12	10	6				832	
	"	12						12	10							810	
	"	14						6	10	6	10	22				756	
	"	15						10								746	
	"	16						12	6	6						722	
	"	17						6	12							704	
	"	18						10	10							684	
	"	19				Returned		65	5	10	(Red Ink)					764	
	"	21						6	24	16	10	10	6	12		680	
	"	22						48								632	
	"	23						15	12	10						595	
	Totals						500	573	228	132	74	60	6	12	= 1085 – 80 returned = 1005	595	OKA

Fig. 5 – Stock ledger sheets, showing only units.

of storeroom facility. In quarters which are crowded, and have not the proper kind of storage bins and shelving, confusion will invariably result. When materials are crowded into a storeroom on improper racks, or shelving, the difficulty of keeping track of the materials needed is increased. Materials will be ordered when a sufficient quantity is already on hand, but cannot be located; or some special line will be overlooked entirely until the last moment, when it is required. This item of storage is deserving of more than passing notice, for thousands of dollars will be spent, and maybe wasted, if great care is not exercised in keeping the supply of materials up to the requirements.

Nearly everyone will agree with the writer, that the advantages of steel racks and adjustable shelving over wooden equipment are very great. In the opinion of the writer, the best steel equipment for storeroom racks and shelving on the market at the present time, is the "Lyon," Figs. 3 and 4, which are manufactured in Aurora, Illinois, by the Lyon Metallic Manufacturing Company. The main features in the "Lyon" racks, are their strength, simplicity, and adaptability, they are fireproof, permanent and occupy much smaller space than the wooden equipment. They are made in standard sizes and one or more sections are complete in themselves, which enables you to gradually increase your storing facilities as business demands, or they can be taken down at any time and assembled in another position.

Each section of bins or racks should be given a letter and each individual bin or shelf a number, so as to enable the location of the materials to be specified on the stock records.

The question of what is a proper storage place and the laying out of the floor space is one which must be worked out to fit the conditions as found in the individual establishment. In a manufacturing business the materials should be located as near as possible to the departments in which they are used. In the larger plants it is sometimes necessary to have several storerooms to accommodate the various classes of material, and in order that they may be located conveniently. The question of proper storage is a vitally important one in every business, and especially so in a manufacturing plant. Ideal conditions are impossible to obtain in all plants, but the very first consideration should be to have a definite place for every class of material, and always keep the class in that one place. The question of the size and weight of the material, and the frequency with which it will be needed, should be the first consideration. Extremely heavy articles should not be stored on the floor, but should be raised to about the height of a truck, which will save labor in loading and unloading. Material which is constantly called for should be kept on shelves within easy reach. The top shelves and inaccessible corners should be reserved for the articles which are seldom called for. As far as possible, all material of the same class should be kept in the same location or section of the storeroom. Above all, a given article should always be kept in the same place.

The Storekeeper and His Duties

The Storekeeper, under the direction of the Purchasing Agent, or in some plants he should be under the Superintendent, should have full charge and authority in the Stores Department. He should have charge of all assistants and storeroom clerks, and must render receipts to the Accounting Department for the entire intake and output of all material and supplies. All requisitions for material and supplies should be made by him, to the Purchasing Agent, and in some cases the requisition should be accompanied by a record of the material on hand at the time of requisition. He should be solely responsible for the maintenance of a perpetual stores inventory system, and for keeping it posted up-to-date. A Storekeeper must, above all things, be exacting, and have such complete control over the men in his employ that the slightest infraction of rules will mean the equivalent to a final check. He should be a man exceptionally well qualified for the position, capable and conscientious—a man who will appreciate the value of the material he handles and be fully alive to the responsibility of protecting the company's property to the letter. He should be familiar with the materials, and know their uses, but it is not necessary that he should be a skilled mechanic. On the other hand, he should not be simply a bookkeeper, or he may be unable to suggest uses for certain material, and, as a result, a lot of dead stock will accumulate, much of which might be employed for some purpose if brought to the attention of the proper parties.

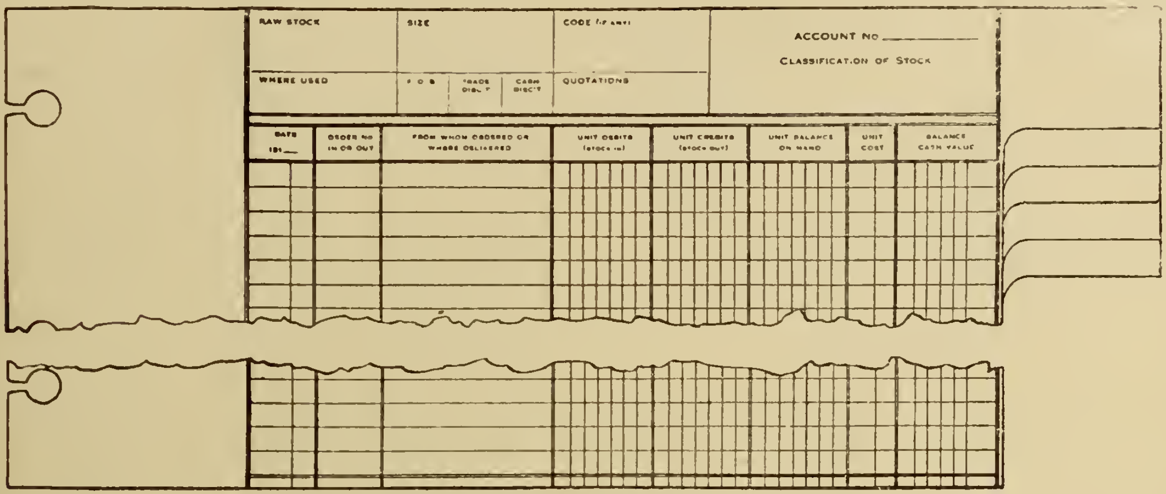
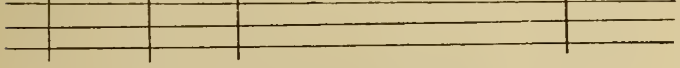


Fig. 6—Stock ledger sheets, showing both units and values.

Aside from the storeroom proper, the Storekeeper should have charge of all material which is stored outside. Lumber, fuel, and heavy castings are examples of material which comes under this head, and his records should include all of this material, and he should have general supervision over its storage in order that he may more readily determine quantities in stock.



LOW STOCK REPORT.

Mr.......................Storekeeper. Date...............

The following items have reached the low limit.

.... Inventory Clerk.

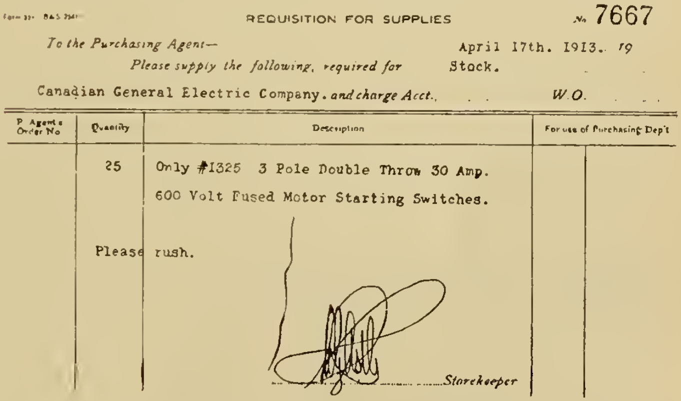
	Low Limit.	On hand.	Material.	Remarks.

Fig. 7—Low stock report.

Stock Records

The purpose of a stock record system is to account properly for all material purchased and used; but the location of the storeroom, its relation to the departments served, and the ability and experience of the Storekeeper, may necessitate certain changes in details to meet local conditions. A theoretical system may be outlined which will afford a perfect record, but, when put into practice, it may prove unsatisfactory, or it may be too expensive for the protection afforded. A practical test is always advisable before a decision is made upon a stock record system for any business. The installation of a stock record system calls for the exercise of judgment of the highest order, for the record of stock, material or supplies is of no less importance than the record of cash, and should be accounted for with the same fidelity as cash, a dollar's worth of material should be regarded as a dollar in gold.

Stock sheets, Figs. 5 and 6, or cards filled topically (or numerically if a symbol system is used) should be kept for each article in stock, and should show the unit, full description, location in the storeroom, normal stock and minimum stock; date, requisition number and quantity ordered; purchase number and name of the firm from whom purchased, dates and quantities received, and the dates and quantities given out, from which a record every day can be obtained of the quantities on hand and quantities on order.



Form 33- B&S 7941

REQUISITION FOR SUPPLIES №. 7667

To the Purchasing Agent— April 17th. 1913. *19*

Please supply the following, required for Stock.

Canadian General Electric Company. *and charge Acct.,* *W.O.*

P. Agent's Order No	Quantity	Description	For use of Purchasing Dep't	
	25	Only #1325 3 Pole Double Throw 30 Amp. 600 Volt Fused Motor Starting Switches.		
	Please	rush.		

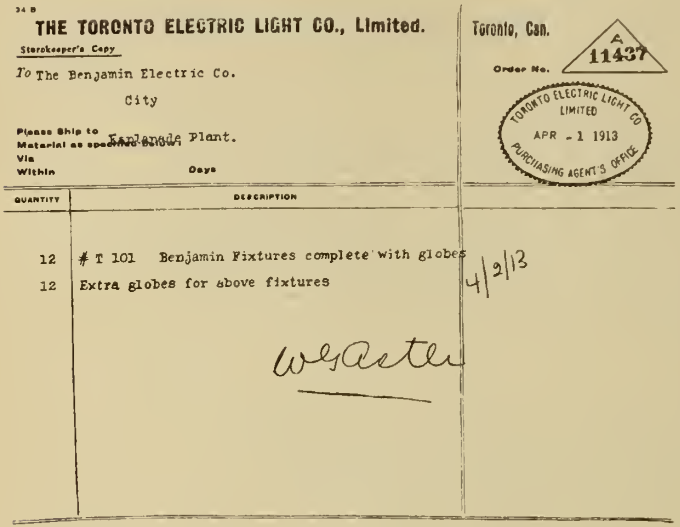
........................*Storekeeper*

Fig. 8—Requisition from storekeeper.

Low stock report forms should be kept in the bins so that the stock clerk removing material is automatically notified that more should be ordered when the minimum quantity is reached.

Ordering Material for Stock

Every article of material should be given a low limit, and when this limit is reached, the stock record clerks should make out a Low Stock Report, Fig. 7, to the Storekeeper. This in turn should be verified by the storeroom foreman, and is recognized as a notice to order more. The report should show the low limit and the quantity in stock. The low limit should always be given, for in some instances it is found advisable to change the limit. Material formerly used in large quantities may be found to be in so little demand that it will be necessary to reduce the limit. At other times it might be found advisable to increase the limit. Before replenishing his supply of any material, the Storekeeper should consult the head of the department using the material to determine if any changes in the specification will be made. Failure to do this sometimes causes the storeroom to become overstocked with obsolete material or material that has become useless on account of changes in standards adopted. When obsolete material accumulates, it should be sold, as it seldom improves with age.


THE TORONTO ELECTRIC LIGHT CO., Limited.
Storekeeper's Copy
To The Benjamin Electric Co.
City
Please Ship to Esplanade Plant.
Material as specified below:
Via
Within Days

Toronto, Can.
Order No. A 11437

TORONTO ELECTRIC LIGHT CO LIMITED
APR - 1 1913
PURCHASING AGENT'S OFFICE

QUANTITY	DESCRIPTION	
12	# T 101 Benjamin Fixtures complete with globes	4/2/13
12	Extra globes for above fixtures	

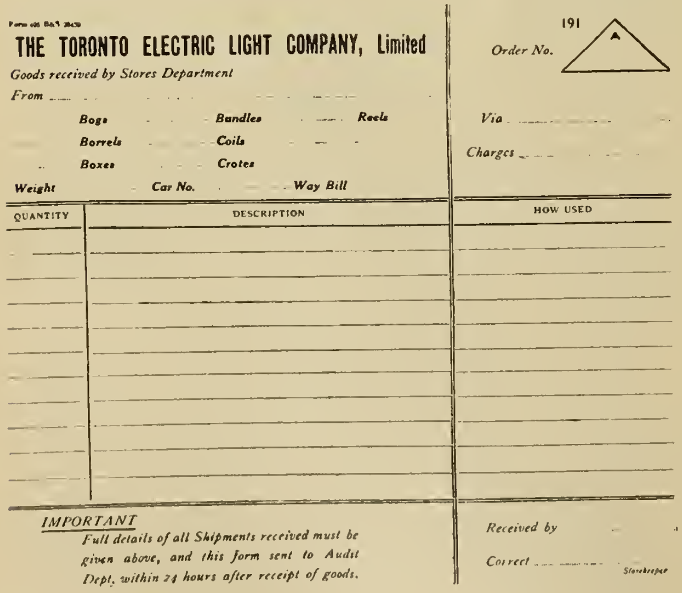
W G Aster

Fig. 9—Storekeeper's copy of purchase order.

All orders for material should be made on a requisition form similar to the one shown in the illustration, Fig. 8. These requisitions should be made in duplicate, one copy being forwarded to the Purchasing Agent, the duplicate being retained by the Storekeeper, and held for the Storekeeper's copy of the purchase order, Fig. 9, after which they should be filed away under the name of the firm with whom the order is placed, to await deliveries.

Receiving Material Into the Storeroom

The Receiving Clerk should have charge of all materials received in the storeroom; he should unpack, make proper preservation of packing material and lumber for future use, check over entire receipt in detail. Under no circumstances should the consignor's invoice be given to the Receiving Clerk to check form, as this too often leads to check marks on the invoice without a count of the material. His memorandum of receipt, Fig. 10, should contain an account of all items and statements, and should be compared with consignor's invoice in the main office entirely independent of him. This method insures absolute certainty regarding the correctness of the amount and quality of the materials received.


THE TORONTO ELECTRIC LIGHT COMPANY, Limited
Goods received by Stores Department
From
Bags *Bundles* *Reels*
Barrels *Coils*
Boxes *Crates*
Weight *Car No.* *Way Bill*

191
Order No. A
Via
Charges

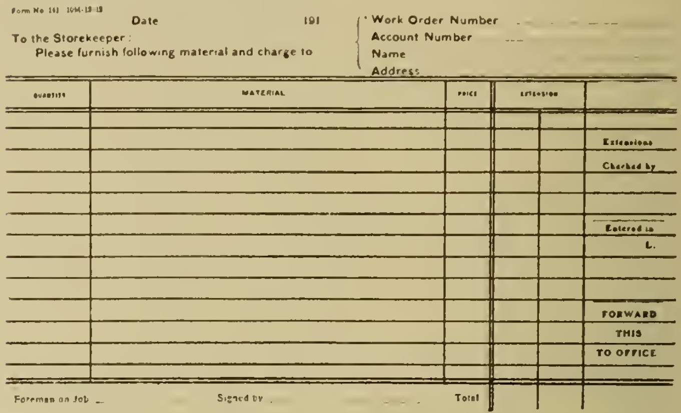
QUANTITY	DESCRIPTION	HOW USED

IMPORTANT
Full details of all Shipments received must be given above, and this form sent to Audit Dept. within 24 hours after receipt of goods.

Received by
Correct Storekeeper

Fig. 10—Receiving report—Storekeeper to auditor's dep't.

After each order has been completed, all papers, from the requisition to the receiving report, which pertain to the order, should be collected, fastened together, and filed away under the order number, while a record should be kept of all order numbers showing the names of the firms on whom the orders were placed.


Date 191
To the Storekeeper:
Please furnish following material and charge to
Work Order Number
Account Number
Name
Address

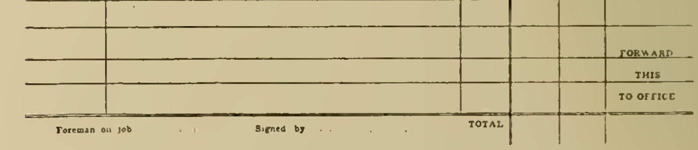
QUANTITY	MATERIAL	PRICE	EXTENSION	
				Extensions
				Checked by
				Entered in
				L.
				FORWARD
				THIS
				TO OFFICE

Foreman on Job Signed by Total

Fig. 11—Requisition form, when material is withdrawn.

Disbursements of Material

No material should be drawn from the storeroom except on a requisition properly signed and approved by the foremen of the different departments, and all material issued and not used should be returned to the storeroom and the proper credit given. Requisitions, Fig. 11, on which material is given out, should show the use to which it will be put, and the name of the operating expense or other account chargeable. They should all be numbered consecutively, the original being sent to the Accounting Department, and the duplicate retained by the Storekeeper for making the necessary records on the stock records, after which they should be filed under the account chargeable. Materials returned to the storeroom should be accompanied by a credit slip, Fig. 12. This form should go through the same routine as the requisitions or charge slips.


Date 191
To the Storekeeper:
Please receive the following material and credit to
Work Order Number
Account Number
Name
Address

QUANTITY	MATERIAL	PRICE	EXTENSION	
				Extensions
				Checked by
				Entered in
				L
				FORWARD
				THIS
				TO OFFICE

Foreman on job Signed by TOTAL

Fig. 12—Credit form, when material is returned.

Handling of Scrap Materials

The handling of second-hand material and scrap is very important, and unless a proper record is taken of all second-hand and scrap material as soon as it begins to accumulate considerable loss will result. All scrap should be collected and stored promptly, and as soon as it accumulates it should be sold, as it is very seldom that old material improves with age, and, while fluctuations in the price of metals may warrant the holding of some material for a short time, it is not desirable to keep it indefinitely in the hope that prices will go up.

General Observations

Some may think that an elaborate system of stock records require too much work and provide too many records, but shortages in material are just as expensive as shortages in cash, and there is no reason why one should not be safeguarded as much as the other. Managers of some factories jealously guard the cash collected daily, which amounts to a few thousand dollars, and it is placed in a bank promptly, even petty-cash accounts must balance to the cent. Let them exchange their cash for material and, beyond checking bills, interest often flags. The Storeroom of any well-organized plant are deserving of the attention and study of every live manager, since much money may be saved by the operating on an efficient basis of this branch of the plant. It is better to have a few extra records and protection than to omit these records and take chances of shortages. In a corporate business, it is the small items which must be closely watched to insure the accomplishment of the greater and bigger tasks which follow business development. Things that seem trivial to the average employee really mean a great deal in the long run if abuses occur, and the old adage, "A stitch in times saves nine," applies very appropriately to the safe-guarding of storeroom materials.

Opening of the "Rockland" Office of the Bell Telephone Company, Rockland Avenue, Outremont, Quebec

On February 28th the Bell Telephone Company of Canada opened its eighth branch office in the Montreal district. This office, known as "Rockland," is located on the east side of Rockland Avenue, just north of Van Horne Avenue, and serves a territory bounded on the east by Park Avenue and extending to Back River, on the line of C. P. R., on the south by Mount Royal Park, and the west on a line near Cote des Neiges Road. This area will take care of the subscribers' lines in the town of Outremont, Mount Royal Heights, Cote des Neiges Village, Model City and Park Avenue extension, the territory extending indefinitely to Back River. About 2,000 subscribers' lines were taken from the St. Louis office and transferred to Rockland at the time of the opening.

The building and equipment of the "Rockland" office corresponds very closely to that supplied for the "Victoria" office opened in July, 1913, and described in the "Electrical News." The building is 88 feet long by 40 feet wide, two storeys and with a high basement, designed to carry another storey in the future. The construction throughout is of the best fire resisting type. Special attention has been paid to fire protection, stand pipes with the standard two and one-half inch hose being placed at different points in the building. Sprinklers are placed on the outside of the building over all windows on the upper storey. The front of the building is finished with hard burnt Laprairie plastic brick, No. 1 quality, and limestone trimmings. The design is of a simple, dignified character with a large window area, giving the building a maximum of light and air.

The main entrance is on the front facing Rockland Avenue, the vestibule of which leads into a commodious entrance hall, from which the operators' quarters are entered, occupying the north half of the ground floor fronting on Rockland Avenue. The operator's quarters contain a lunch room, kitchen, rest and retiring rooms and sick room. In the basement beneath is the locker room, reached by a private staircase, as well as the operators' toilet and bath rooms.

The south half of the ground floor is entirely devoted to the housing of the power and terminal apparatus associated with common battery switchboards of the type installed. The entire top floor is used as an operating room and contains the subscribers' and incoming trunk switchboards. It is particularly well lighted and well ventilated. The whole of the central portion of the floor of the operating room, that is between the switchboards, is raised 13½ inches higher than that portion of the floor on which the switchboards stand. This construction permits of the operators sitting on chairs of normal height, and, at the same time, more readily permits of their making any connection to the most distant parts of the switchboard which they are obliged to reach. At the same time access to all parts of the back of the switchboard is exactly the same as in buildings of earlier construction where the entire floor of the operating room is on one level. A good fire escape is provided outside the building, reached by doors swinging outward from the operating room and from the operators quarters to the ground. In the basement are situated furnace and coal rooms, men's lavatories, battery room and cable terminal entrance.

The switchboard equipment is of the latest standard common battery relay type, and was supplied by the Northern Electric and Manufacturing Company, Montreal. The lines enter the building underground in lead covered, paper insulated cables and are connected to the main frame by silk and cotton covered insulated cables. The main, intermediate and relay frames, the coil racks for the lines and in-trunk switchboards with their fuse panels, the power plant and two-position inspector's desk are located in the terminal room at the east end of the ground floor.

The power plant consists of the main battery of 11-G chloride cells and a smaller set of 11-E-11 cells, the latter battery being used to reinforce the main battery for long distance work. Two Western Electric Company's motor-generator sets are provided for charging the larger battery, one being held in reserve in case of a breakdown. Each consists of a Western Electric Company's generator of 18,000 watts capacity at 30 volts, directly connected to a 30 h.p., 550 volt, 3-phase, 25-cycle motor. The generators are of a standard telephone design specially built for charging telephone batteries, having a large number of segments in their commutators and with peculiarly shaped pole pieces, the idea being to eliminate noise from the associated telephone service when the battery is being charged. The smaller battery is charged by a smaller generator which has an output of 600 watts.

Two machines are provided for furnishing alternating current for ringing subscribers' bells and with special interrupters arranged to give automatic intermittent ringing of subscribers' bells on calls originating from the other offices. These interrupters give an interrupted direct current to work the many signalling circuits required for an equipment of this type. The necessary switches, circuit breakers, measuring instruments, etc., are mounted on a black slate switchboard. From this terminal room the lines are run to the switchboards on the floor above in switchboard cables supported on structural steel runways.

Two separate switchboards are provided, one to care for the subscribers' lines directly connected to this office and the other one, the in-trunk switchboard, to complete connections that originate from the other offices. Both switchboards have a capacity of 10,400 lines and are equipped for 4,000 lines. They are equipped with the latest types of circuits; those of the in-trunk switchboard include the keyless incoming trunk circuits.

All the structural steel telephone apparatus in the terminal room is painted with aluminium paint (not the usual grey iron filler paint) and gives the room a bright and cheerful appearance. The new scheme of cutting over by operating the cut-off relays electrically was used and proved very successful.

Electric Railways

Track Construction and Maintenance

By Mr. L. A. Mitchell*

The location of a line of railroad is generally governed by the topography of the country between the points it is intended to connect, but the topography too often receives too much consideration, or, rather, an alignment is established with the idea of evading heavy grading work and with too little consideration of the grades and curves that will exist and will have to be operated over after the line is completed. After the preliminary survey has been made and the topography of the country is thoroughly known to the engineer, he instructs his locating party to locate a line with a certain limiting degree of curvature and limiting gradient. These two are inseparable, as a curve of any given degree will offer to the operation of a train a resistance which is equivalent to a certain grade.

Train Resistance Due to Curves, Grades and Sliding Wheels

It is unfortunate that the experiments for determining the amount of curve resistance to the operation of a train have not been more numerous or more satisfactory. The results which have been obtained, however, show that in all probability the resistance of a curve is about ½ lb. per ton per degree of curvature. The resistance offered to train operation due to grade is 22.4 times the rate of grade per 100 ft. per ton or 14/33 times the rate of grade per mile. This equation and the first on curve resistance may be combined, and it will be found that a 1-deg. curve will offer resistance equal to a grade of 0.025 ft. per 100 ft.

It can readily be seen that for flatter curves the resistance to train operation due to curvature for single-car trains will not be great, but in the operation of 100,000 car miles this resistance will be considerable. Nearly all electric railways are compelled to have curves of 100 deg. or greater, on account of passing through towns and cities, and, according to the preceding assumption, a 100-deg. curve would be equivalent to a 2½ per cent. grade on tangent track. However, I do not believe any of the experiments noted were made on curves of such high degree, and no doubt other forces enter into the operation of the car around a curve of such high degree. On these sharp curves it is necessary to have guard rails, at least a single guard rail, and many engineers think a double guard rail is necessary. The wheels which come in contact with these guard rails necessarily offer greater resistance to the movement of the car than if no guard rails were present.

Another resistance is the sliding of wheels, both lateral and longitudinal. This resistance enters into train operation no matter what the curvature, but it is much greater on sharp curves. From the standpoint of maintenance, curves increase the cost of wheel maintenance as well as the cost of renewing rails. In addition, we have the increased amount of power necessary to carry a train over a given piece of track. Probably the most noticeable example of the resistance of curves is when we stop one of our heavy interurban cars with one or both trucks in a sharp curve, particularly when the line voltage is weak. With practically all wheels in contact with guard rails—and with the trucks at an angle, the resistance is maximum just before the car commences to move.

Drainage

Drainage conditions can very often be materially improved from a maintenance standpoint if proper consideration is given to this matter at the time the road is located and constructed. This has been especially neglected in the construction of city tracks. We can find many examples where it is almost impossible to keep the track in any kind of surface, owing to the fact that the water which has followed down along the rail or seeped through the street covering has found its way to the foundation of the track, where no way has been provided for it to get away. Such track will have to be rebuilt very much sooner than if a tile drain had been placed under the foundation and connected with sewer inlets at street intersections. If the track foundation is concrete, the tile drain should be laid under the concrete and surrounded by cinders, crushed stone or some other loose material so as to afford opportunity for any water that might get under this foundation to drain into the sewers. It is also advisable to place surface drains to take off any water that may run along the flangeways, at least at street intersections, and connect these to sewer inlets.

Foundations

Many of us in Ohio and Indiana found out several things about the foundations of our bridges after the flood of 1913. From what information I can obtain, I believe that not less than 95 per cent. of the bridge failures on both steam and electric lines were due to poor foundations. Almost invariably these foundations had not been carried deep enough or they had been placed on a material which is not considered reliable when subjected to excessive erosion.

Many foundations were found to have been placed on gravel varying from 1 ft. to 4 ft. or 5 ft. below the stream bed, and during the excessive high velocity of the water in the streams they were undermined and the superstructure damaged. It was found that other foundations were placed on a thin layer of hard pan which varied from 1 ft. to 3 ft. in thickness and was partly soluble in water. As this material was washed out the foundation failed. In one case the bridge abutment was placed on gravel, although solid rock existed about 4 feet below the base of the foundation.

If it was not known before, it was certainly proved during last year's flood that a gravel foundation for piers or abutments carried to any reasonable depth is not safe without driving piles. It has also been clearly determined that a stratum of hard pan should be of greater thickness than 1 ft. or 2 ft. before it is used as a foundation. In all probability, a stratum of hard pan should have a thickness of not less than 8 ft., and the foundation should be carried at least one-half of this distance into the foundation material. Further, this hard pan should not disintegrate when allowed to stand in water.

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* Superintendent Track and Roadway Union Traction Company of India; presented before the C. E. R. Ass'n., Cleveland.

Investigation as to the quality of material can easily be made by using a 2-in. or 2½-in. auger inside of a 3½-in. pipe. A sample of the material can be obtained as frequently as desired and to a considerable depth. This method, of course, will not be very satisfactory in a gravel-like material when any boulders are present.

Ballast

Ballast is a material that is just as essential to the riding qualities of good track as good rails and ties. Poor riding track which is so on account of poor ballast conditions introduces stresses into a car body which will eventually loosen nearly every joint of the whole structure. If the car is allowed to run until this condition is pronounced, it means ultimately that the extra car shop labor and material will cost more than proper track ballasting and surfacing.

The Pennsylvania Railroad, in 1911, made some rather extensive tests to determine the best kind of a cushion for broken stone ballast to be placed between the sub-grade and the ballast proper. Its experiments were made with the idea of using broken stone ballast entirely, but the object was to find out how much and what kind of material was the best to take care of the drainage of the ballast proper and also to distribute the load transmitted through the ballast over the sub-grade. These experiments showed that cinders and good clean gravel were probably the two best materials that could be used as a ballast cushion; also that about 2 ft. of either of these materials under the ballast proper gave the most uniform distribution of load over the sub-grade. For the loads electric railways ordinarily carry, 1 ft. of this material would be ample thoroughly to distribute the load over the sub-grade, and this with an additional 1 ft. of regular ballast, either stone or gravel, would give very excellent track. Inasmuch as cinders are a continuous by-product of most electric railways, it would seem that very excellent track could ultimately be obtained by using this material as ballast and then putting in gravel or broken stone on top of the cinders for the regular ballast course.

Cinders have a peculiar quality of absorbing water, nor do they wash away so fast as gravel when water flows over the track. On the other hand, cinders will compress and after use for a considerable time will have a more uneven surface than gravel.

Standard Construction Proposed for Sidings

For many years it was possible for electric roads to adopt standards for construction because their method of transportation was new and subject to rapid developments. I am submitting drawings as possible standards for side-track construction.

Fig. 1 shows the construction of the No. 9 frog used in the foregoing siding, with 70 lb. A. S. C. E. rail. This frog has been found to be very satisfactory. All of the plates under this frog are ½-in. thick, and all fillers are rolled steel. This frog has but one spring and one holding-down bar. It is fully equipped with foot guards and an anti-creeper. All bolts in this frog are of special heat-treated steel, whose elastic limit is not less than 75,000 lb. per sq. in. and whose ultimate strength is 100,000 lb.

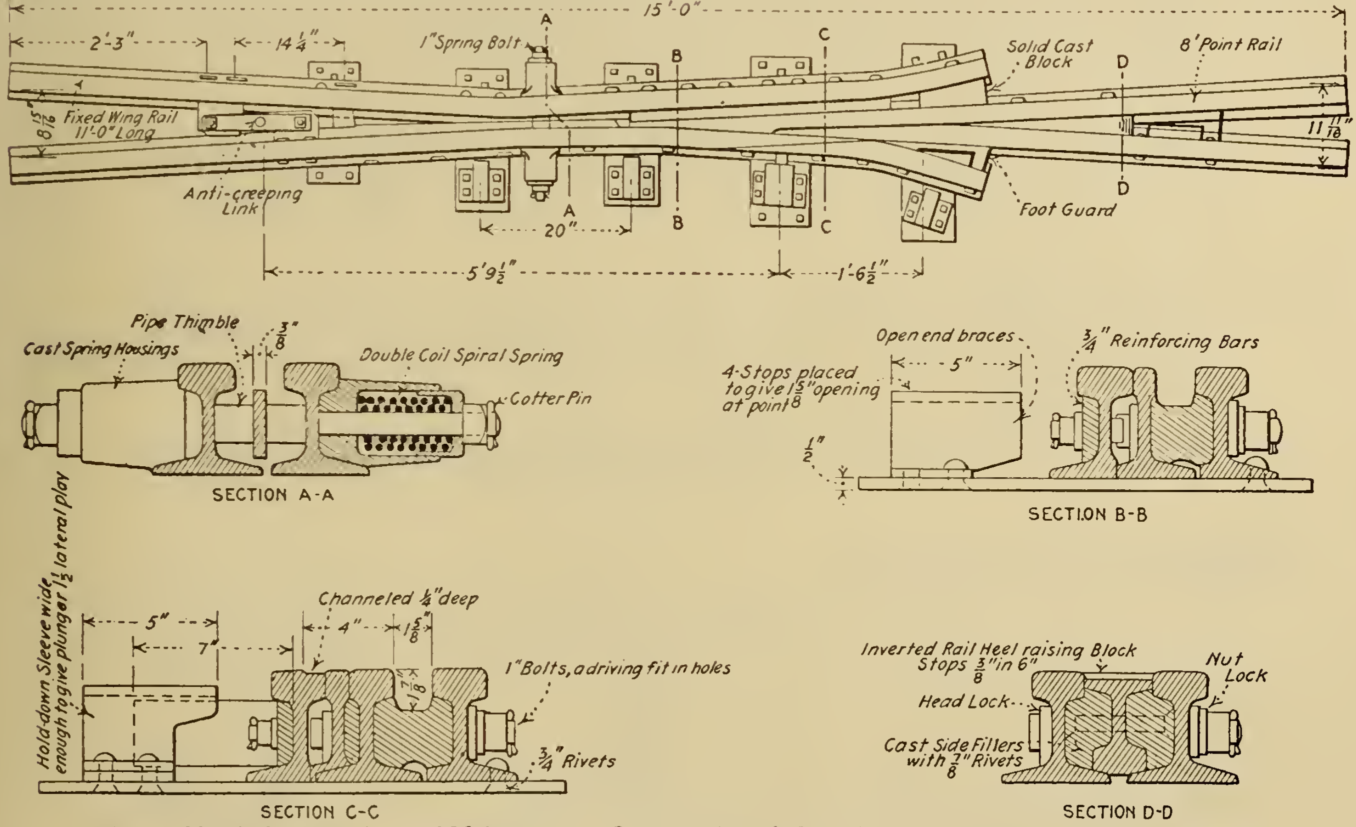

Fig. 1—Track Construction and Maintenance—Construction of No 9 Frog for through-type electric siding.

Fig. 2 is a detail of the switch points for this standard siding, showing dimensions of plates and rail braces; also the extent of the side and base planing. These points are 15 ft. long and are equipped with foot guards. One head rod is adjustable and the other two rods are rigid.

Street Construction, Including Joints

The foundation material, weight and section of rail and the design of switches and frogs are features of street construction which are very important, but I do not believe that there is any one thing that is of as much importance as the construction of the joint. It has been the experience of practically every electric railway that the joint has failed first and that reconstruction was made necessary on account of the failure of the joints, whereas the rail in between the joints had many years of life.

In modern street construction four types of joints are used. All of these are tight, with the ends of the rails milled so that they will fit tight together with no allowance for expansion and contraction. These types are the driven-bolt joint, riveted joint, welded joint and the combination of bolted and welded or riveted and welded. As far as I can ascertain, the purely welded joint has given trouble. The only explanation I can see for this is that in applying the weld the ends of the rail are heated to a temperature high enough to change the molecular construction of the steel in such a way as to cause fractures of the rail just back of the weld. I have not heard of any failures of the combination joint where bolts or rivets and a small weld were used. I believe that practically as satisfactory a joint can be obtained as any now in use by using driving fit bolts or rivets and supporting the whole joint by means of a broad steel tie. This gives a supported joint, and if the rails are properly ground at the joint so that no hammer is allowed to start, this type promises as long a life as any now in use.

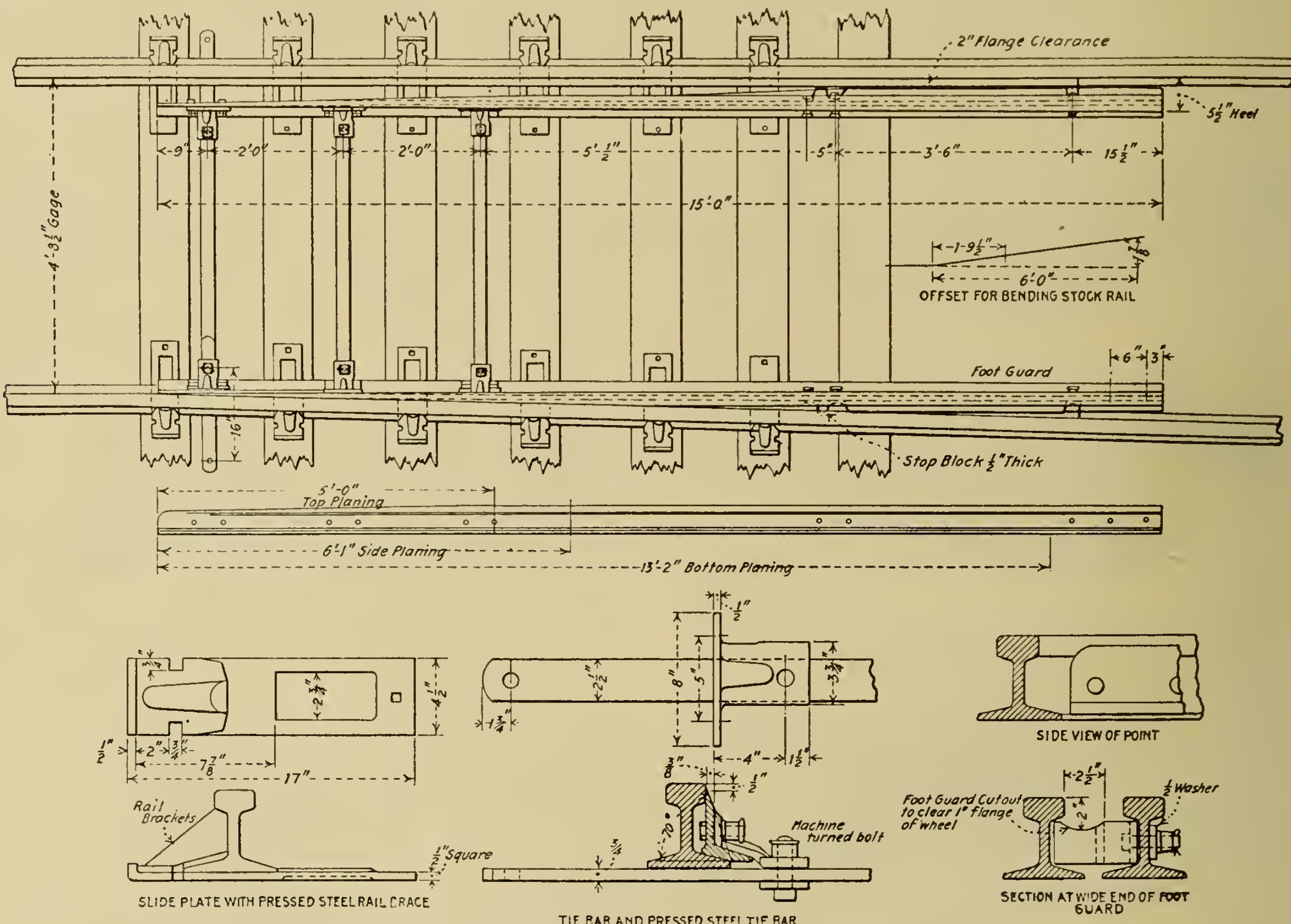

Fig. 2—Track Construction and Maintenance—Detail of switch points for standard siding.

Some companies are buying their rails with the holes drilled or punched a fraction of an inch smaller than the size of the bolt that they intend to use. Then, by means of reaming machines, they ream these apertures out to a true round hole of the exact size that they wish to obtain. Very satisfactory results have been obtained, however, by having these holes drilled to the proper size at the rail mill and then using machine bolts of the same size as the hole. I do not believe that a joint bolt for street track of the heaviest type of construction should be less than 1⅛ in. in diameter. Fig. 3 shows the supported bolted joint described.

Where street track is constructed with tight joints and steel ties are used at the joints or throughout the total length of the track, joint bonds and cross bonds can be eliminated by welding the joint bars to the rail and the rail to the steel tie. All rail joints in street track should be ground to an even surface, as the specifications under which we buy rail allow for a possible maximum difference in height of the rails of 3/64-in., and this is sufficient to start a hammer which will very quickly cup the rails.

The foundation of street track is a question upon which engineers differ very widely. Some say that street track foundation should be absolutely rigid, others say that it should be elastic like open track construction, and still others say that it should be a combination of the two. Some engineers assert that they have obtained good results by placing track on ordinary stone or gravel ballast, tamping it well and then concreting on top of the ballast as a foundation for the pavement only. Another type of foundation is to lay from 6 in. to 12 in. of concrete in the bottom of the trench, place in about 1 inch of sand, surface the track on this sand and then fill in to the proper elevation with concrete. The remaining method is to have concrete from the bottom of the trench up to the cushion for the pavement. It is impossible with any kind of ballast to tamp up track so that there will be no settlement, and consequently the pavement will finally work loose about the rails. It would seem, therefore, that a rigid foundation will give a construction which will require the least maintenance of track and pavement.

The proper type of rail for street construction has also been the subject of a great deal of thought. I believe that we will eventually come to the use of T-rails entirely, with a section of sufficient height to allow for paving. This height should not be less than 7 in. A chamfered granite block has been found to give excellent service as a flangeway. Higher carbon steel rails have probably not been used sufficiently to determine the extent of their advantages and whether or not they are worth the increased expense. It is undoubtedly true, however, that for bolts a special steel is advisable. Special steel bolts with an elastic limit of not less than 75,000 lb. per square inch and an ultimate strength of 100,000 lb. are giving a very much stronger joint construction and are also rendering excellent service in built-up railroad crossings.

Guard Rails, Special Work and Crossings

In constructing short radius curves at street intersections it is a general practice to have the guard rail higher than the running rail. This is so whether the guard is rolled as part of the running rail or a rail is used as a guard. I have found it very satisfactory, however, to use a guard rail of the same height as the running rail, and to bolt this to the running rail every 2 ft. by 1-in. machine bolts with steel lugs holding the guard rail at the proper distance from the running rail to secure the proper flangeway. In case a rail is used as a guard rail, the method described gives a much more substantial form of construction than using a rail of less height than the running rail and supporting it on steel plates to give it the proper elevation because the equal height guard rail has, as a firmer foundation, the same ties that support the running rail. This equal-height construction also makes an easier riding street intersection for vehicles.

The raising of flangeways in frogs and mates so that the flange of the car wheels will ride while the tread of the wheel is passing over the opening in the ball of the rail has been widely discussed, and it has been stated that chipped flanges will occur where this type of special work is used. But if a car is operated at the proper speed over a piece of special work with raised flangeways, chipped flange trouble is not probable. A common mistake in the raising of flangeways is that the approach is made too steep so that the flange of a wheel will receive a strong blow when it comes in contact with the raised portion of the flangeway. We want to avoid pounding in the special work as well as at joints, and the raised flangeway with a long flat approach is the way to eliminate this hammer.

Railroad crossings and the expense of maintaining them have always been a source of much concern to both steam and electric engineers. Out of 152 railroad crossings during the year 1913, I had eighteen new installations, at an average cost of $260 per crossing. If I include these new crossings, my average maintenance cost per crossing was $68 for the year. An average maintenance cost excluding the cost of the new work but including the cost of installing it was $37.50. It is impossible to arrive at any average cost of maintenance for a railroad crossing, because it depends entirely upon the amount of traffic, but this cost can be decreased and the life of the crossing increased by having a construction which allows as little movement as possible between the various pieces. All of the frog bolts should be driving fit and of special steel, the filler should fit the rail sections under the ball and at the base, and machine knee braces should be used. A rigid inspection of crossings by taking them apart will often reveal a very poor fit between the fillers and the rails and also between the knee braces and the rails. To obtain rigidity in a crossing and reduce the possibility of movement between various parts, solid cast manganese crossings are used to a large extent. Manganese steel, however, will break easily, and I am inclined to believe that the better type of crossing is the built-up type with manganese steel running and easer rails.

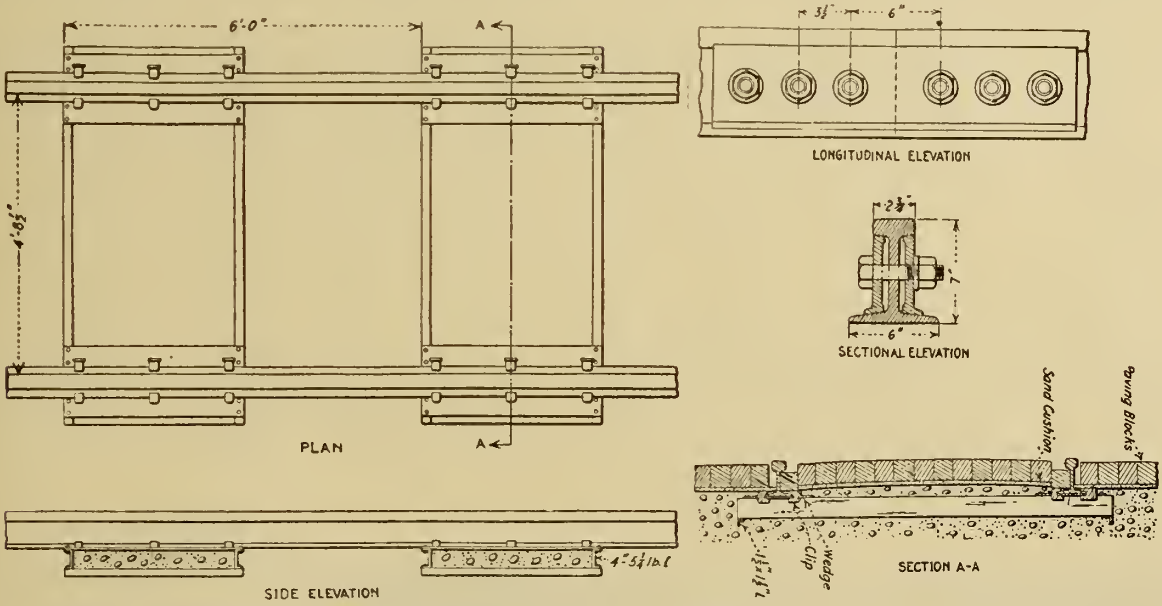

Fig. 3—Track Construction and Maintenance—Sections and plan of city T-rail construction; also details of joint.

The foundation of a crossing should be continuous throughout its whole length and should extend beyond the joints of the wing rails. In many cases timbers are used and placed under the steam railroad rails throughout the entire length of the crossing to give them a continuous support. I have found, however, that a steel structure consisting of channels and plates riveted together, filled with concrete and placed in its entirety on broken stone ballast gives very satisfactory results. A crossing with this type of foundation as installed under the two main line tracks of the Big Four Railroad did not require any attention for a whole year, whereas in the same length of time an ordinary built-up crossing installed at practically the same time, but without this type of foundation, showed considerable wear and was working to quite an extent, even though the traffic over it was probably less than one-half that of the crossings with the steel foundation. The latter showed very slight wear for the period mentioned. From my experience it looks as though this type of crossing foundation is a decided improvement over other methods, but it may be that longer experience will show that even this foundation can be improved.

Records

The cost of construction and maintenance work must be known to the engineer in order that he may determine, while the work is going on, that it is not more expensive than it should be. Materials purchased for renewals must be kept track of to ascertain if they are rendering proper and efficient service. To obtain this information the records must be such that the desired information will be at hand at the proper time and in the proper form.

B. C. Alterations

The B. C. Electric Railway Company have recently made alterations in the equipment which carries the company's transmission lines over the Second Narrows of Burrard Inlet, these furnishing light and power for North Vancouver and adjacent districts. The main transmission line from the generating plant on the North Arm is tapped in Burnaby at a point near the Second Narrows of the Inlet where the Inlet is so narrow as to afford a desirable point for such a crossing. The lines were originally carried on a pair of high wooden masts, these being erected about ten years ago. About two years later, during the high wind prevailing on Christmas Day, these original masts were broken down. A new pair of masts was then erected and have been in service since that time. With the development of industrial points at the head of the Inlet large vessels now pass through the Second Narrows from time to time and it became necessary, in order to accommodate the high masts of these vessels to raise the wires.

The old masts were two in number and of the single pole type, each composed of two poles properly fastened together and guyed. The north mast was 158 feet in height and the south mast 174 feet. The span between the two masts was 957 feet and the clearance above high water at the sag point of the wire was 123 feet. The new masts on the north side are 210 feet in height and on the south side 215 feet. The span between the masts is 951 feet and a clearance of 160 feet above high water mark is given at the sag point. The locations of the new masts are 50 and 25 feet respectively from the old masts, the plans providing for an entirely new construction and the demolishing of the old masts.

The new masts are of the double pole or "H" construction, each being composed of two-mast poles, placed 18 feet apart. On the north side the masts are guyed to a two-pole anchor tower, 130 feet in height. On the south side the mast is guyed to a four-pole anchor tower 95 feet in height.

The masts carry eight wires, these consisting of two 3-phase circuits, 34,600 volts and two telephone wires. The three-phase circuit wires are of galvanized plowed steel wire consisting of six strands of seven wires each. Each wire is of 2,500 circ. mill. area. The core is of hemp, this cable being one-half inch in diameter.

The two circuits are placed side by side at six-foot centres, the arrangement being vertical. The centre wire is offset two feet to increase the clearance when snow or sleet may prevail. The telephone wires are placed at the ends of the cross arms.

The complete transfer of the transmission lines from the old masts to the new construction was completed on February 21st. This being the only connection with the company's North Vancouver sub-station, which supplies current for a tram system and public and private lighting and power business, it was necessary that the interruption in connection with the transfer of the wires should be as brief as possible and at such times as would inconvenience the company's patrons but little.

Peterborough Radial Extensions

The Peterborough Radial Railway Company will carry on considerable extension work during the present summer. The city is laying one mile of pavement along the business street and the company are entirely removing their old tracks from this portion of their system and replacing them with 80A and Loraine 80-335 rail sections. In addition the company will install two maganese-steel railroad crossings and two crossings of built-up construction. The company are also running a siding to the C. P. R. depot and will operate a separate depot car in future, meeting all passenger trains day and night. At the present time the Peterborough Radial System is running on a 15-minute schedule, but additions to rolling stock and alterations at certain parts of the system will enable them in the early future to operate a 12-minute service and within a few months thereafter a 10-minute service.

The following judgment of Judge Winchester regarding the cleaning of snow from the streets by the local street railway company is of interest:—"I find that it is the duty of the Toronto Railway Company to keep their track allowances, whether for a single or double line, free from snow and ice at their own expense, so that the cars may be used continuously, and that if the fall of snow is less than six inches at any time the company must remove the same from the tracks and spaces if the City Engineer so directs, evenly spread the snow on the adjoining portions of the roadway, but should the quantity of snow exceed six inches in depth, the whole space occupied as track allowances (for double tracks 16 feet six inches and for single tracks eight feet three inches) shall, if the City Engineer so directs, be at once cleared of snow and ice and the said material removed and deposited at such point on or off the street as may be ordered by the City Engineer. And I find by Section 25 of the said Act that the Railway Company shall not deposit snow, ice, or other material upon any street or public place in the city without having first obtained the permission of the City Engineer."

New Books

Elementary Principles of Illumination and Artificial Lighting, by Arthur Blok, B.Sc., A.M.I.E.E.; Scott, Greenwood & Son, London, Eng., publishers, price 3s. 6d. This book outlines the principles underlying artificial illumination and its measurement as a subject in itself, quite apart from any consideration of the commercially competitive merits of particular illuminants. The book is addressed to students, engineers and such others as may be concerned with the distribution and installation of lighting equipment. A very practical treatise: well illustrated, by line sketches for the most part.

Wireless Telegraphy—By W. H. Marchant, Whittaker & Company, London and New York, publishers; price 5s. This is a handbook for operators and students who already possess some knowledge of electrical science. The book deals, in sections, with the production and retention of electric oscillation and waves, description and process of construction of the apparatus required for a radial telegraph installation, followed by a description of a number of systems —Marconi, Poulsen, etc. The final chapters deal with the apparatus necessary and the methods of carrying out all the more important measurements under special conditions. One chapter deals with the interpretation of diagrams; two chapters are given over to the regulation of instruments for licensed radial telegraph stations. The book is illustrated and written throughout in a very practical manner and is well printed.

Illumination

Indirect Residence Lighting

By Mr. A. D. Curtis

The illustrations herewith represent the scheme of illumination by indirect fixtures, in a private residence. Fig. 1 represents the reception room; Fig. 2 a general living room. Fig. 3 represents, as the diagram on the bowl will indicate, a dining room fixture. Fig. 4 is a general plan of the ground floor.

In the use of indirect units as shown in these reproductions, the excellence of illumination results depends very largely on the scheme of decoration of the rooms. It may be said in a general way that the nearer approach the decorations are to pure white, the more efficient the illumination will be, but it does not follow that all the rooms must be finished in this color. The walls of the reception room shown in Fig. 1 are decorated in green, which gradually merges into the cream color of the ceiling. The furnishings in general are green and mahogany. This room is 16 ft. x 15 ft. and is illuminated by four 60-watt tungsten lamps equipped with individual, one-piece, silvered, glass reflectors of the horizontal type, housed in an opaque bowl made of composition and finished to harmonize with the green decorations of the room. The length of suspension is 27 inches from the ceiling to the top of the reflectors.

The gross wattage is thus seen to be one watt per square foot. As shown in Fig. 4, which represents a plan of the ground floor of the residence under discussion, the horizontal lamp values are indicated at a number of points. In the reception room the illumination would appear to be ample if somewhat variable. In the extreme corner the intensity is .9. Indeed, the owner of this house finds the illumination values unnecessarily high and the lamps are controlled by a four-way switch which makes it possible to light either one lamp, two lamps or four lamps. This room is also equipped, as shown in the plan, with a portable indirect floor lamp which has replaced an art glass table lamp shown in Fig. 1. This lamp is equipped with one 150 watt tungsten lamp and a large vertical, one-piece, silvered glass reflector. The silk shade is illuminated by three 10 watt frosted tungstens. This art lamp was not in use when the tests shown were made.

The walls of the living room, Fig. 2, are finished in a light green with white ceiling, white woodwork and light furnishings. This room is illuminated with four 40 watt tungsten lamps equipped with individual silvered glass reflectors. The fixture is of composition equipped with a pull chain and suspended 27 inches from the ceiling. The illumination reading at the centre of this room gave 2.8 horizontal foot candles.

The decoration of the walls of the library is gold up to the moulding with a dark cream above the moulding extending to the ceiling and becoming a light cream as the ceiling is approached. The furnishings are brown and mahogany. This room is illuminated only by a portable indirect table lamp equipped with one 150 watt tungsten with vertical type one-piece silvered glass reflector and three 10-watt lamps for illuminating the shade. The gross wattage is approximately .75 watts per square foot. It will be seen from the plan that there is ample intensity for reading purposes anywhere in the neighborhood of the lamp. Furthermore, the lamp can be moved so as to get the best results in any desired location.

The decoration of the dining room is a blue above dado. The ceiling is white mottled with pale blue to give a sky effect and is heavily beamed. The furnishings are dark. The illumination is by means of five 60-watt lamps equipped with reflectors as before, the units being suspended 27 inches from the ceiling. The design of the unit is shown in Fig. 3. The gross wattage of this room is approximately .96 watts per square foot and illuminations are shown for nine different test positions.

The bedrooms are for the most part finished in light

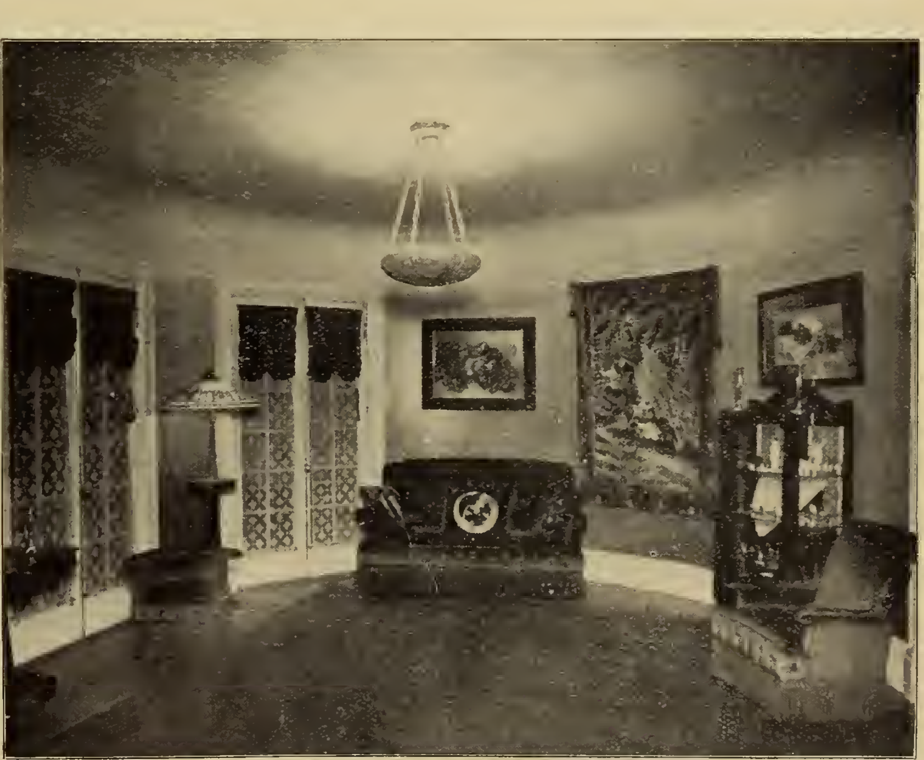

Fig. 1—Indirect lighting of reception room.

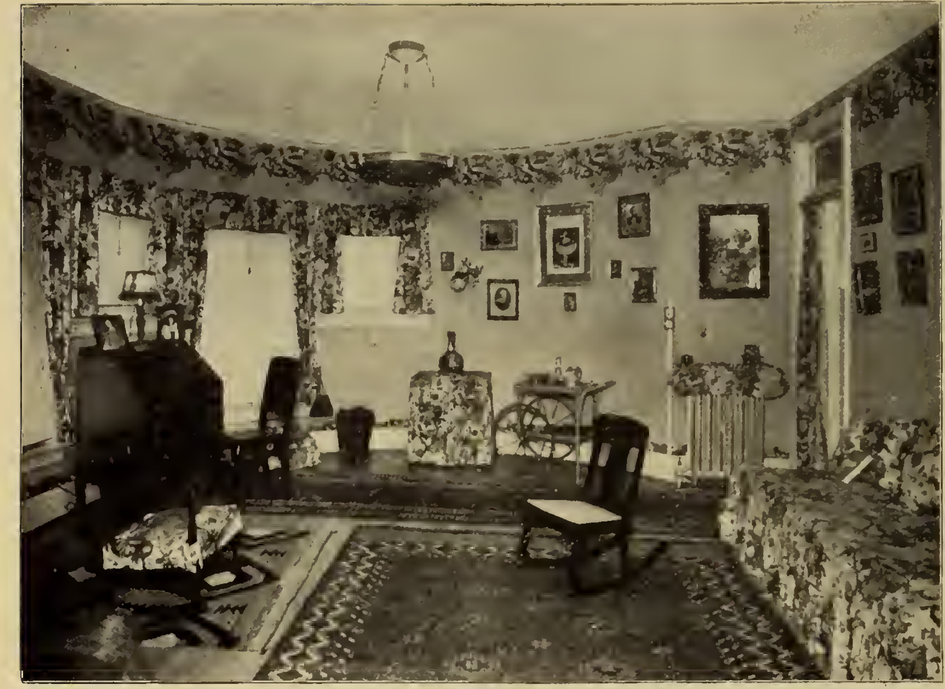

Fig. 2—Indirect illumination in general living room.

Fig. 3—An ornate fixture.

colors and indirect units are used throughout with wattages varying but below unity in each case. The same is true of the bathrooms, halls, kitchen, the den and porch. In this particular house a feature is made of the porch unit in that it is housed in wicker-work which gives to the room a summer-like atmosphere. The reflectors and fixtures in this installation were manufactured by the National X-Ray Reflector Company.

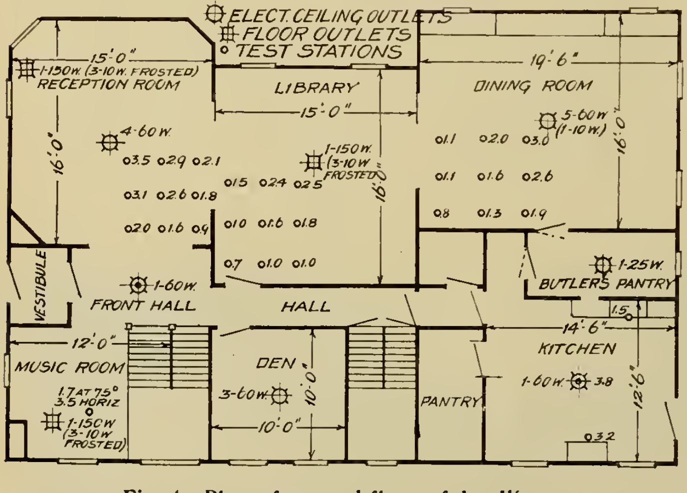

Fig. 4—Plan of ground floor of dwelling.

The Immediate Future of the Half-watt Mazda Lamp

By Mr. L. A. Hawkins*

The announcement last summer by the General Electric Company that an incandescent lamp had been produced with a specific consumption of one-half watt per candle naturally gave rise to much speculation upon the effect this new lamp would have on electric lighting. Since then, the characteristics of the new lamp have been fully described, but speculation continues and some misapprehensions are manifest. Therefore it may be worth while to devote a few minutes to a consideration of the probable immediate future of the new gas-filled mazda lamp.

It would be equally presumptuous and futile to attempt to anticipate developments by mapping out the metes and bounds of that portion of the field of electric lighting which the gas-filled mazda lamp will eventually occupy. It is not the purpose of this paper to make any such attempt, but rather, by considering some of the well established characteristics and peculiarities of the lamp, to try to determine the general direction of probable development which may effect that development.

When a gas-filled lamp is compared with a vacuum lamp, its most striking characteristic, aside from its higher efficiency and higher intrinsic brilliancy, is that its efficiency varies with the size of the filament. In vacuum lamps the efficiency at a given filament temperature is independent of the diameter of the filament, except for the relatively slight effect on loss through leads. In gas-filled lamps the diameter of the filament is an important factor in determining the efficiency. The reason for this is that at a given temperature the wasted energy, i.e., the heat lost by conduction in the gas, is practically independent of the filament diameter, while the useful or radiant energy is proportional to the surface, and therefore to the diameter of the filament. Langmuir gives the specific consumption of a tungsten filament at 2800° Abs. (2527°C.) in nitrogen at atmospheric pressure as 1.54, 0.74 and 0.50 watt per candle for filaments of 1, 5, and 50 mils dia. respectively. It is clear from these figures that the large filament has, in nitrogen, an advantage over the small filament which it does not have in vacuum. Nor do these figures tell the whole story. A 5 mil filament at 0.74 watt per candle, and a 50 mil filament at 0.50 watt per candle, though running at the same temperature, will not have equal lives. The large filament should outlast the smaller several times. In order to get a comparison based on equal lives the specific consumption of the smaller filament must be raised or that of the larger lowered. The difference in efficiency will then be more marked.

At best in large sizes

The gas-filled lamp is thus at its best in large sizes, and it is therefore in large sizes that the first commercial development should be looked for. Large size means large filament diameter and that means large current. The filament can and should be coiled in a close helix, so as to give the effect of a larger diameter, but the permissible diameter of the helix is limited, because, if it is made too great in proportion to the diameter of the filament, the filament will sag rapidly early in the life of the lamp and the efficiency will fall correspondingly. Therefore, even though the filament is wound in a helix, the specific consumption is relatively so much greater in low current lamps that the first commercial lamps, except for special purposes, will naturally be designed for currents above, rather than below, 5 amperes. For multiple circuits of 110 to 125 volts, this means lamps of over 600 watts, in which specific consumptions of 0.75 down to 0.6 w.p.c. in the larger sizes can be looked for.

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* Engineer, Research Laboratory, General Electric Co.

Lamps of such wattage and candle-power are so far removed from the sizes of lamps adapted for house-lighting that it is not to be expected that the gas-filled lamp will be scaled down in the near future to house-size.

But there are other circuits on which the high efficiency mazda of more than 5 amperes is immediately applicable. Most street series incandescent circuits now carry 6.6 or 7.5 amperes, and on such circuits the new lamp can be substituted directly for the old and reduce the specific consumption to about 0.7 w.p.c.

A better efficiency is obtainable on alternating current circuits by using a lamp of 20 amperes or more, with a compensator to transform the current to the proper amount. With such a lamp a life of well over 1,000 hours can be obtained at a specific consumption measured on the primary side of the compensator of not more than 0.5 watt per candle.

The Effect on arc lamps

This combination of a high current lamp and compensator has several advantages over a lower current lamp designed for direct connection in the circuit, other than its higher efficiency, amounting to at least 30 per cent. more light for the same wattage. In the first place, on a series circuit, some kind of shunt protection is necessary to take care of burnt out lamps, and a shunt reactance is one of the simplest forms of such protection. This, in effect, is what the compensator is. Secondly, since these new lamps run much nearer the melting point of the filament than do the vacuum lamps they are more sensitive to excess current. The compensator can be designed to reduce the current rise in the lamp for a given rise in the series circuit. Even if the compensator is not designed to give this effect, the greater mass of the large filament, with its time lag in temperature, makes it less sensitive to sudden rises of current than is the lamp with the smaller filament. This time lag is very noticeable when current is thrown on or off a 20 ampere lamp. There is a very appreciable interval before the lamp reaches full luminosity or falls below incandescence.

On the basis of equal life, the large filament runs at a somewhat higher temperature than the smaller filament and therefore gives a somewhat whiter light, but this difference would not ordinarily be noticeable except where direct comparison is possible.

The 20 ampere lamp, with its high efficiency, high intrinsic brilliancy, and relatively white light, enters directly into the arc lamp field. Its efficiency is about three times that of the enclosed a.c. arc of 6.6 amperes, which still lights more miles of street than any other lamp, and is on the same order as that of the luminous arc. In connection with relative efficiencies, it should be remembered that it has been the practice to rate incandescent lamps in watts per mean horizontal candle-power, the measurements being taken on the bare lamp, while arc lamps are usually measured complete with casing, reflector and outer globe and rated in watts per mean hemispherical candle-power. In making comparisons care should be taken to reduce efficicandle-power and wattage.

The 20 ampere half-watt mazda seems certain to find a field in street lighting. It can in the present state of its development be made efficiently in sizes as small as 300 watts, 600 candle-power, or even smaller by resorting to special expedients to prevent excessive heat loss through the leads when the filament length is reduced below that corresponding to 15 volts. There is no upper limit to the candle-power and wattage.

In connection with outdoor applications, one point is of interest and importance. The bulbs of nitrogen-filled lamps run much hotter than those of vacuum lamps. Temperatures approaching 200 deg. C. or even higher are to be expected. The reason is that, whereas in the vacuum lamp much the greater part of the energy in the filament is radiated directly through the bulb without heating it, in the nitrogen-filled lamp much the greater part of the energy is taken up by the gas as heat and so delivered to the bulb, with the result that the top of the lamp especially runs very hot. Now when cold water is suddenly thrown on an ordinary glass bulb at 200 degrees C. the bulb cracks. Therefore, for outdoor use it is necessary either to make the bulbs of special low-expansion glass than can, when hot, withstand a sudden cold shower, or so carefully to house the lamp as to prevent the access of water. Housing is not a disadvantage for the larger lamps, since the intrinsic brilliancy is so high that a diffusing outer globe is desirable to prevent glare, and for the 20 ampere lamps the compensator must be housed anyway. In the design of the housing, however, it is necessary to provide adequate ventilation. A lamp which will last 1500 hours if properly ventilated will not last 50 hours if the ventilation is insufficient. This is because over-heating of the glass sets free water vapor within the lamp which attacks the filament and rapidly spreads a dense black deposit over the bulb. Therefore if the lamps within it are to have a reasonably long life, the housing must be designed with a knowledge of the lamp requirements and its temperature limitations.

A street lighting proposition

It is often asked what effect the half-watt mazda will have on arc lamps. In all probability its effect will be to make better arc lamps. The high efficiency, brilliancy, steadiness, relatively white light, and low cost of maintenance, will make the new lamp a dangerous competitor of the arc lamps; but the case of the arc lamp is far from hopeless. Half a watt per candle is a higher specific consumption than that of the most efficient arc lamps to-day, and in the race for still better efficiencies the arc lamp has the great advantage that, whereas at about 0.2 watt per candle a tungsten filament reaches its melting point, there is no such fixed limitation on the efficiency of the arc. In brilliancy the arc has a slight, but very little advantage. The slight relative unsteadiness of the arc is not a disadvantage in the eyes of some, who see in it a snap and vivacity which is lacking in the steady though brilliant incandescent lamp. The half-watt mazda, while much more nearly white than the one-watt per candle mazda, is not so white as the luminous arc or the white flame carbon arc. Further increase in arc lamp efficiencies will lower the cost of maintenance per candle-power, and, especially where the cost of power is high, will give the arc lamp a decided advantage.

Thus it is altogether probable that the net result of the advent of the new lamp in the arc lamp field will be that better incandescents and better arcs will co-operate in furnishing better street lighting systems for all conditions. In some cases those conditions will best be met by the mazda, and in others by the arc.

The Dealer and Contractor

"Doing It Electrically"

The proven utility and convenience of the electric motor coupled with the reasonable rates charged for electric energy in Winnipeg are responsible for the fact that a great many of the general contractors have purchased electric motor-driven equipment for their building operations.

The National Construction Company, Limited, deserve special mention as one of the progressive contracting firms. Nearly all of their hoisting machinery, derricks, and concrete mixers are motor-driven. On the new Law Courts Building, now under construction for the Manitoba Government, seven motor installations have been made and not one break-down from an electrical standpoint has occurred. At the present time the following motor load is connected up and in service:—

Motor No. 1—Derrick	22½ h.p.
Motor No. 2—Lift	7½ h.p.
Motor No. 3—Derrick	15 h.p.
Motor No. 4—Saw Rig	5 h.p.
Motor No. 5—Derrick	15 h.p.
Total	65 h.p.

All of the above motors are three-phase, 60-cycle, 550 volts, except No. 2, which is a 500 volt d.c. motor.

All construction machinery is electrically operated.

Graphic Meters

A complete line of continuous writing curve drawing instruments has recently been completed and placed on the market by the Esterline Company, Indianapolis, Ind. These instruments are now furnished for the measurement of all electrical quantities such as volts, amperes, watts, etc. Electric speed recorders, service recorders, pyrometers and graphic counters are included in this line. These meters are furnished in switchboard rear connected type, wall or front connected type, and portable type. The general construction of all these types is the same with the exception of the case and the method of making connections. The clocks, meter elements and recording mechanism are the same in all types.

The instruments are of the direct writing type. The pen, which is in contact with the paper at all times when writing, is placed in the end of a tubular pointer which is pivoted and provided with a counter-weight. The pressure of the pen on the paper is regulated by this counter-weight which is adjusted so that there is just sufficient pressure to hold the pen on the paper without creating heavy friction. The ink supply is retained in a stationary well provided with a cover to prevent spilling of the ink when instruments are moved about.

The clock is of the eight-day jewel balance wheel type. It is provided with two driving springs and a third spring which operates the rerolling device provided for winding up the finished chart. On some types, the reroll is omitted and the finished record allowed to feed through a slot in the bottom of the case. The clock is fitted with a driving roll equipped with pins at each end which engage perforations along the margins of the record chart. The driving roll is geared through the two idlers to the clock stud which furnishes the driving power. Different combinations of gears are supplied so that five chart feeds, ¾, 1½, 3, 6 and 12 inches per hour may be obtained on any clock by putting on the proper gears. For furnishing rapid chart feeds, a special attachment is provided on the clock, arranged so that shifting a small lever on the front of the clock case instantly changes the chart feed from a given number of inches per hour to the same number of inches per

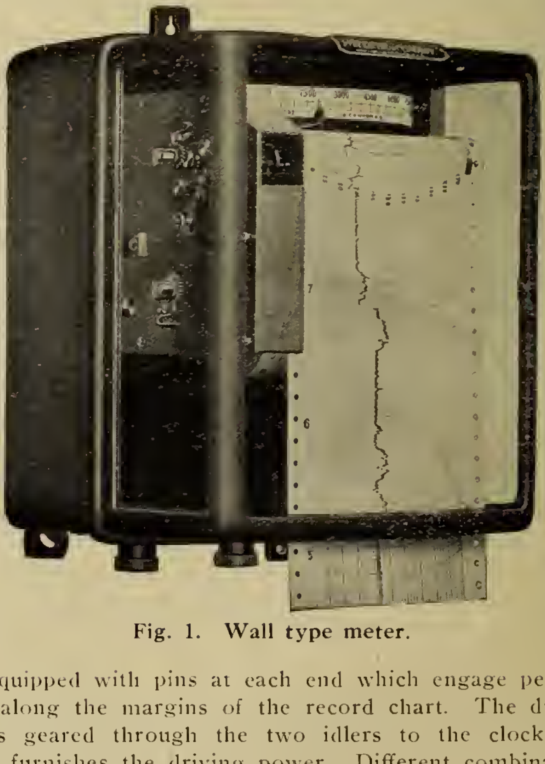


Fig. 1. Wall type meter.

minute. The clock is mounted in a dust-proof case and attached to the door, which in turn is held in the case by four screws.

Meter elements are assembled complete in one unit and may be removed from the instrument without dismantling. For direct current ammeters and voltmeters a powerful D'Arsonval permanent magnet type movement is used. For direct and alternating current wattmeters, alternating current voltmeters and ammeters a dynamometer type construction is employed. No iron is used in the magnetic fields of the dynamometer movements so that meters of this type are accurate on all frequencies and respond promptly to voltage or load variations. The armature shaft of the meter element is provided with a bracket which carries pivots in which rest the pointer carrying the pen.

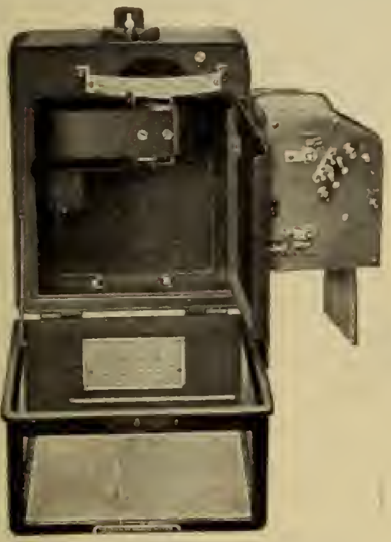


Fig. 2. Interior view wall type.

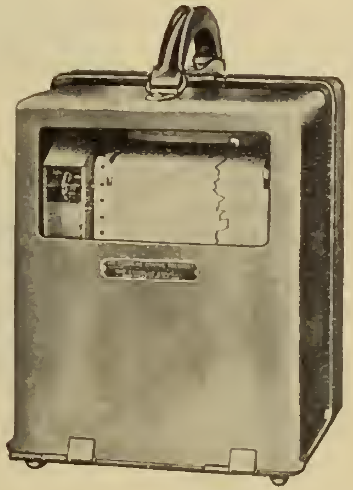


Fig. 3. Portable type.

Alternating current instruments are provided with adjustable damping devices consisting of a rotating vane immersed in a small cup containing oil or some other viscous liquid. The amount of damping is varied by adjusting the height of the cup, the quantity of oil or the quality of the liquid. Direct current meters do not require damping as the armature is wound on a metallic frame in which eddy currents are induced when the armature rotates in the magnetic field of the permanent magnet.

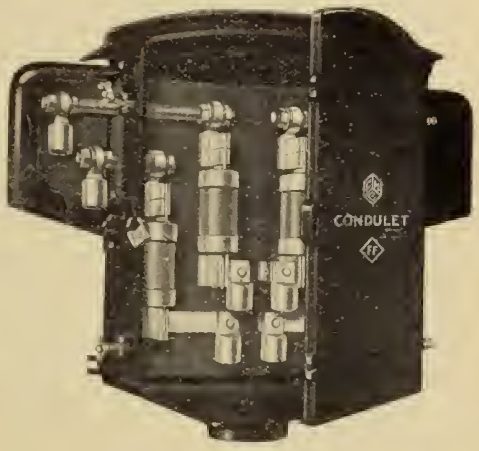
The power consumption on these instruments is so low that they may be operated from shunts or transformers already installed. Voltmeters and wattmeters require from 4 to 5 watts for each voltage element on 110 volts. Direct current ammeters consisting of millivoltmeters and shunts require only about one-third ampere for the instrument. Due to the direct writing construction, no extra control circuits of any sort whatever are made use of.

These instruments are used on switchboards for obtaining voltage and output curves. They are used for getting power consumption of motor driven tools and for general efficiency engineering. These instruments are especially valuable when it is desired to get an accurate record of power consumption in circuits where the load is fluctuating very rapidly.

The Allen-Bradley Company announce that their Chicago representative, Mr. Frank L. Gohl, has moved from his old quarters at 540 Commercial National Bank Building, to 307 Webster Building, 327 LaSalle Street, Chicago, Ill. This change was necessitated by the decided increase in business, the old offices proving too small.

New Condulets

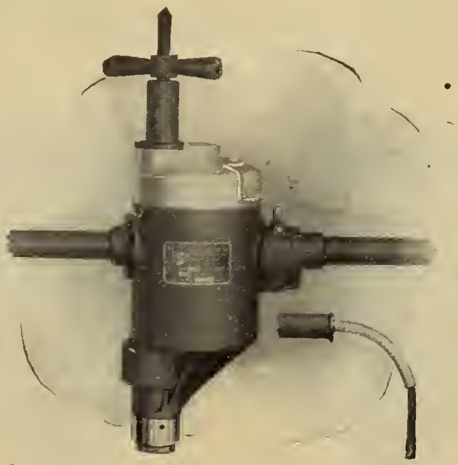
The accompanying cut represents a new type of condulet designed for use where conduit is used to protect, from mechanical injury, service wires from an overhead system. For this condulet three advantages are claimed. First, in case of short circuit in the conduit the fuses open the circuit. Second, a short circuit on any one of a number of individual services is localized by the intermediate fuse protection thus saving the transformer fuses and preventing interruption in the other services supplied from that transformer. Third, it is possible by removal of the fuse to completely disconnect the service outside the building. These condulets are made in two forms—a smaller form for use with 30, 60 and 100 ampere cut-outs and a larger form for use with 200, 400 and 600 ampere cut-outs. This material has been placed on the market by the Crouse-Hinds Company of Canada.



New type condulet.

A Universal Slow Speed Control

The illustration herewith represents a new type of Van Dorn electric drill fitted with a slow speed universal motor.



This drill is especially adapted for work in marble, tile, switchboards, billiard tables, etc. The Canadian agency is held by Messrs. R. E. T. Pringle.

The town of Outremont, Que., have just closed a contract with the Eugene F. Phillips Electrical Works, Limited, for the supply of over 20 miles of paper insulated, lead covered, steel taped, armoured cable for a working pressure of 6,600 volts. This cable will be installed under a five-year guarantee.

Bottom Connection Meters

After discussing the subject for several months the B. C. Electric Railway Company have decided to alter their policy with reference to the type of meters used for their light and power connections. Heretofore the company have almost exclusively used "top connection" meters. The company's new policy demands the use of "bottom connection" meters. Among the reasons for the change brought forward at the departmental discussions on the subject were the following:

(1) Meters are very often installed in damp locations. In such cases the "top connection" does not afford proper protection for the equipment, whereas the "bottom connection" affords well nigh perfect protection.

(2) The requirements of the civic and municipal electrical bureaus demand that meters shall ordinarily be installed at a considerable height. Under these circumstances it is difficult to closely inspect the contact points with the "top connection." With the "bottom connection" the condition of the contacts can be seen from the floor at a glance.

(3) Should there be loose contacts and consequent overheating with the "top connection" the melting of the terminal would result in the flow of the metal into the meter.

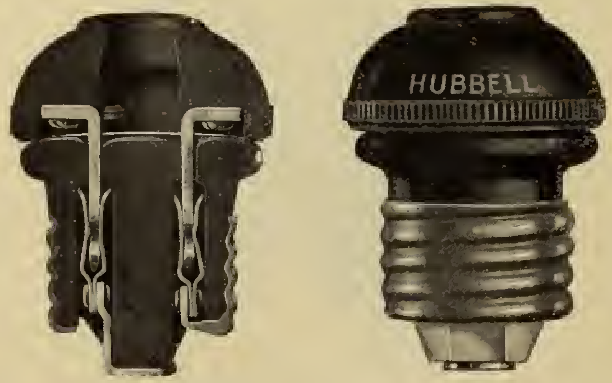
(4) With the use of the "bottom connection" it is comparatively easy to notice any attempt to tamper with the meter owing to the connection several feet lower down, not concealed in any way and affording a chance to see the inspection seal without trouble. With the "top connection" the company has found that it is possible to tamper with the meter in such a manner as to escape the casual notice of the inspector.

(5) In the case of testing the meter the operation may be carried on with much less difficulty where the "bottom connection" is used.

The new policy of the company will go into force in the near future and their contracts for meters be based on specifications framed accordingly. All new meters placed will be of the new type and the "top connection" meters now installed will be replaced as soon as their life is ended.

New Hubbell Plugs

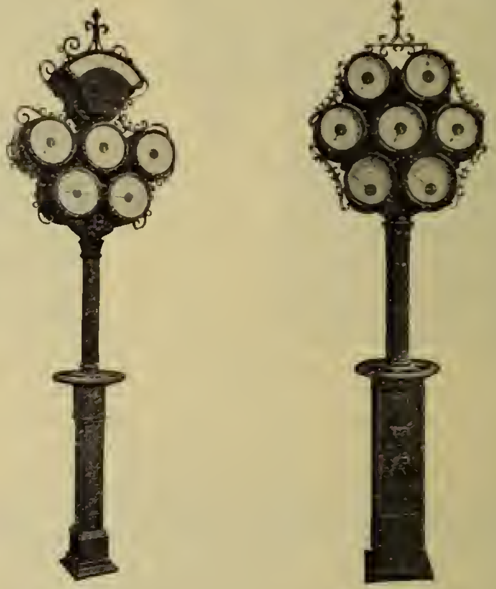
The two cuts herewith represent the latest development in Hubbell attachment plugs. The reproductions are the exact size of the plug. This plug is for use in an ordinary lighting socket where contact is to be made and broken frequently, as in portable equipment such as table lamp, toaster, percolator, etc. The base of the plug screws into the receptacle in the ordinary way and the push-in cap fits snugly into the base. To break the current this cap requires only a slight pull which does not disturb the base or strain the socket. When inserted in the socket the cap projects only about half an inch so that the device is unusually neat.



Advise our Subscription Department if you do not receive your Electrical News promptly.

Instrument Posts

Instrument posts, as shown herewith, are now used whenever a device is required upon which to mount meters in a power station in place of using an instrument switchboard. The wiring is concealed in the interior of the posts. The advantage of instrument posts over panel switchboards are that they permit a very convenient and ornamental mounting for meters, beside locating them in such a position that they can readily be observed without obstructing the general view of the operator. The usual arrangement is to place these posts so as to form a support for the railing of an operating gallery, each post being placed in front of its respective controlling apparatus which is usually located on a suitable controlling pedestal. The posts may be secured to the floor either by bolting the shank to the side of channel iron beams located under the floor, or by using a bolted flange collar, secured to the post and provided with holes for holding down bolts. When a concrete floor is provided, a socket can be supplied which may be set into the floor, and which is arranged for bolting to the flange collar. The standard ornamental posts have plates provided at the places where hand railing is usually attached, but when required hand rail bosses may be substituted. These bosses are drilled to take a standard 2-inch pipe, 2⅜ inches outside diameter. Posts with panel bases cannot be arranged for hand railing. Two styles of pedestals are made, with ornamental bases and with panelled bases suitable for mounting control apparatus. Each of these styles is also made with stationary top and with swivel top which can be turned about by means of a handwheel just above the base. These instrument posts are manufactured by the Westinghouse Electric and Manufacturing Company.



The Ferranti Electrical Company of Canada, Limited, have just been appointed sole agents for Messrs. Bruce, Peebles & Company, Limited, Scoltand, for the province of Ontario and all Western Canada. As is generally known Messrs. Bruce, Peebles & Company build all classes of electric motors and generators, large alternators, motor generator sets, rotary converters and also the Peebles La Cour converter. It is interesting to note that the first La Cour converter to be installed in Canada has just been completed at Regina. In Great Britain and in South Africa where these machines have been on the market for some years, they are already securing a very large proportion of the business in converting machinery.

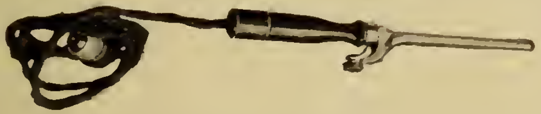
Universal Chemical and Electrical Laboratories

A company known as the Universal Chemical & Electrical Laboratories has recently been formed at Waterford, Ont., and has taken over the building formerly occupied by the Dominion Telephone Manufacturing Company. The new Company propose manufacturing, on an extensive scale, telephone supplies, electrical fixtures, etc.

Factory of new company.

Electric Curling Iron

The electric curling iron supplies the long-felt demand for a simple, reliable, and economical self-heating curling iron. By its use the fire hazard of the flame iron is eliminated and a uniform and more easily controlled heat is obtained. A new electric curling iron is being manufactured and sold by the Westinghouse Electric and Manufacturing Company. This curling iron can be used with stored heat, as with the flame-heated curling iron. In addition, it can be used with continuous heat, a use which cannot be obtained with the flame-heated iron. For use with stored heat, the iron is first heated by connecting it to the electric circuit. When it is hot, the swivel plug is pulled out, disconnecting the cord and electric circuit. It is then like the flame-heated curling iron and is used in the same manner. When it gets cold, the plug is pushed into place until it is hot again. When it is used with continuous heat, the swivel plug enables the user to grasp the iron in such a way that it can be freely rotated by the thumb and fingers without twisting the cord. It can be used with or without the hair clamp, which is easily removable. As the input is only 15 watts, it costs only about one-tenth of a cent an hour to use this curling iron with the average price of current.



Refillable Fuses

At a recent convention of the Western Association of Electrical Inspectors it was recommended unanimously that Rule 68 of the National Electric Code be so revised as to permit the use of refillable cartridge fuses. A report of the proceedings of this convention discussed the matter as follows; we are indebted for this report to the Economy Fuse & Mfg. Company, Chicago,—

"The subject of refillable fuses was again brought up from the preceding day's discussion, by Victor H. Tousley, Chicago, who moved that the Association recommend that Rule 68d be so revised as to permit the approval of refillable cartridge fuses. This motion was carried unanimously. Before this matter was dropped, however, H. E. Bloomer, Milwaukee, Wis., asked as to the experience with refillable fuses. A number of speakers said that one type of these had proven very satisfactory; that these fuses had stood up under severe tests and seemed to meet all requirements. B. H. Glover said the Underwriters' Laboratories have not recommended any refillable fuse because Code requirements do not permit such approval. A certain type of refillable fuse had met all the requirements of rating and performance but could not be given formal approval on account of the restriction just mentioned. F. A. Barron said he regretted to see the Association apparently take a stand which meant really a lowering of standards in fuse requirements. There is no doubt abuse of standard cartridge fuses on account of the fallibility of the human element, but he doubted the wisdom of the proposal to approve any type of refillable fuse.

A. L. Eustice, Chicago, replied to Mr. Barron by pointing out that the best opinion in the inspection field seems to welcome a reliable form of renewable cartridge fuse as a solution of the vexatious fuse problem. He felt that the opposition to the use of renewable fuses was based entirely upon theoretical grounds; experience in the field with various types of renewable fuses has shown that renewable fuses can be built that will meet the performance requirements and solve the old difficulties of improper fusing. It has been conclusively shown that a proper type of renewable fuse can be and is being properly renewed and is therefore suitable for certain cases where there is evident need for a fuse of this type. In industrial plants, where unavoidable conditions cause frequent blowing of fuses, it is necessary that renewals of the fuse be made at moderate cost. If this is not done an improper fuse element will be inserted. A fuse is used for the very purpose of safeguarding the circuit and apparatus to which it is connected and it should blow when an abnormal load or other condition exists. Records of jobbers show that repeat orders for standard non-renewable fuses are not received to any extent after the first order, showing that the fuses are not being replaced by new units but are refilled on the premises, evidently in an improper manner in altogether too many cases. A properly constructed renewable fuse permits easy inspection of the fuse element and this insures that it is being properly refused. The denial of renewal results only in the temptation to improperly defeat the object of a fuse."

Well Equipped Electrically

The new factory of the Canadian Connecticut Cotton Mills at Sherbrooke, Que., is practically completed and will be one of the best equipped factories, from an electrical view point, in Canada. The Canadian General Electric Company have the contract for the supply and installation of the electrical equipment including motors, transformers and other apparatus.

There will be 28 squirrel cage induction motors, 3-phase, 60 cycle, 550 volts, located as follows:—

Locality	Motors	H.P.	R.P.M.
Opening Room	1	10	1800
Weave Room	1	15	1800
Picker Room	2	10	1800
Picker Room	3	5	1800
Carding Room	1	50	900
Carding Room	1	20	1800
Carding Room	1	35	1200
Spinning Room	8	20	1800
Spinning Room	5	10	1800
Weave Room	2	35	1200
Twisters	2	25	1200
Cloth Room	1	20	1800

The switchboard consists of six natural black slate panels equipped with horizontal edgewise instruments and K-5 oil switches. One panel controls the 2200 volt incoming line and a three-phase transformer stepping down to 605 volts. Provision is made on this panel for reading the current and voltages in all three phases. The three main power feeder panels are all equipped with one ammeter arranged to read the current in each phase, one indicating wattmeter and series trip oil switch. The fourth power feeder panel controlling two small capacity circuits is equipped with quick-break fused knife switches. The sixth panel controls single phase lighting circuits and is equipped with plain lever fused switches, one voltmeter and one ammeter.

The transformer equipment consists of three oil-cooled 200 kv.a. single-phase, 60-cycle, 2200/2145/2090/1980- 608-volt units.

Efficient Heaters

The Toronto Hydro-electric Department recently showed a very interesting window display of electric heating equipment manufactured by the National Electric Heating Company, Limited, Toronto. The exhibit consisted of portable units in sizes from 660 to 3,000 watts and wall type units in 1,500 to 10,000 watt sizes. It is claimed for these heaters that an installation of 1½ watts per cubic foot is ample, even for residences, and the manufacturer claims that during the past cold snap when the temperature was ranging around 20 below zero they maintained a large sub-station in Toronto at a temperature of 65 Fah. where the consumption worked out at .93 watts per cubic foot. The accompanying illustration shows the exhibit in the Hydro window. This company also manufacture portable and mantle type luminous radiators.

Window display of portable heaters.

Are Exclusive Agents

Canadian Allis-Chalmers, Limited, Toronto, have been appointed exclusive agents for Canada and Newfoundland, of the Avery Automatic Scales. The parent factory at Birmington, England, was established almost 200 years ago, and is, we believe, the oldest and largest scale company in the world, comprising factories in England employing 5,000 and another at North Milwaukee, Wis. These scales are of the utmost value in power plant installations for checking the amount of coal and water feed to boilers, in weighing liquids for sugar, oil and other industries, for use in cement plants to determine automatically the proper proportions of the various ingredients, etc. The automatic grain scale is a recognized feature of every modern elevator and mill. The Avery scale in the Canadian Government Elevator at Port Colborne constitutes the largest installation and the largest automatic grain scale in the world.

The St. Lawrence Pulp & Paper Company have awarded a contract to the Canadian General Electric Company for the supply of two 1,000 kw. turbo-generators. The Structural Steel Department of the Canadian Allis-Chalmers, Ltd., will also supply the steel necessary in the erection of the pulp and generating buildings at present under way.

Canadian Felt Products

The Booth Felt Company of Gananoque, Ont., established about a year ago, is now completely equipped to manufacture felt washers, felt gaskets, and indeed every description of felt goods for mechanical and commercial purposes. This plant is practically a duplication of the N. E. Booth plant of Brooklyn, N.Y., established some eight years ago. The management report that business during the opening months of the present year has been exceedingly encouraging and that apparently purchasers are at last appreciating that all their requirements in felt can be purchased without going outside of Canada. The fact that the company have been able to fill all orders promptly has doubtless added greatly to the increase in their business.

A Good Cable Order

The Montreal Light, Heat and Power Company have closed a contract with the Eugene F. Phillips Electrical Works, Limited, Montreal, for the supply of approximately 16 miles of paper insulated lead covered cable. This is the first contract given out by the power company in connection with placing their wires underground under the scheme laid out by the electrical commission of the city of Montreal.

New Companies

The Warman Rural Telephone Company has been incorporated with head office Warman, Sask.

The Northern Ontario Pulp & Development Company has been incorporated; head office Toronto; capital $150,000.

The Mornington & Wellesley Telephone Company, Limited, has been incorporated with head office Millbank, and capital $12,000.

The Canadian Provincial Power Company has been incorporated with head office Truro, N.S. The object of the company is to generate hydro-electric power at Sheet Harbor making use of a fall on the East River. Power will be transmitted and distributed through the counties of Pictou, Colchester, Antigonish, Guysboro and Halifax.

Trade Publications

Mineral Production of Canada—Annual report of the Department of Mines, Ottawa, for the year 1912.

Furnace Efficiency—A handbook entitled "How to Build Up Furnace Efficiency," by Jos. W. Hays; published by the author at Rogers Park, Chicago. Price $1.00.

Inland Waterways of Canada.—The water transportation problem of Canada frankly discussed. Published by the Great Waterways Union of Canada, executive offices Berlin, Ont.

Starting Switch.—Bulletin B-541, January, 1914, issued by the Allen-Bradley Company, Milwaukee, Wis., describing and illustrating their type H Resistance Starting Switch for alternating current induction motors.

Fused Switches.—A folder issued by the Electric Service Supplies Company, illustrating and describing their fused lighting switch. The same company have issued a bulletin describing and illustrating a number of "safety first" signs.

Canadian General Electric—have issued the following publications—Bulletin No. A4190 describing their small motor generator sets, types MIC and MCC; also folder entitled The "Ironclad-Exide" Battery for Electric Vehicles; also pamphlet describing a Trumpet Electric Horn for automobiles. The above publications are well illustrated and describe the various equipment very thoroughly.

Mr. K. Farah, owner of the Charlton-Englehart Company, is prepared to develop High Falls if he is given control.

Current News and Notes

Brantford, Ont.

A by-law will be submitted to the ratepayers on March 23 authorizing the council to sign a purchase agreement for the Grand Valley Railway which calls for the payment of $253,000. The by-law will ask for $270,000 so as to allow of extensions and betterments in the system.

Brandon, Man.

A meeting of representatives of Winnipeg, Portage la Prairie, Brandon and contiguous municipalities was held in Brandon on March 5th at which the matter of obtaining a supply of power from Winnipeg was fully discussed. It is the intention of Portage la Prairie to go ahead with their line this summer and Brandon could be served from Portage. Considerable enthusiasm was shown at the meeting and it looks as if the proposition would result in some actual work being done this year.

Burford, Ont.

The enabling by-law has been carried by this municipality.

Calgary, Alta.

The contract for the current year's supply of meters has been divided among the Canadian General Electric Company, the Canadian Moloney Electric Company, and the Packard Electric Company.

Camrose, B.C.

The electric light rates have been reduced from 18c per kw.h. to 15c. per kw.h. as a result of a surplus for the year 1913 of approximately $2,000 in the operation of the electric light plant.

Chatham, Ont.

The Light & Power Commission have decided to improve their street lighting system during the coming summer by the addition of a number of arc lamps.

Dane, Ont.

La Mine d'or Huronia, E. H. York, general manager, are installing hydro-electric equipment at the present time, the electrical end of which is being supplied by the Canadian Westinghouse Company. The machinery includes one 235 kv.a., a.c., coupled type generator, 3-phase, 60-cycle, 2,200 volt, 360 r.p.m. with belt driven, 10 kw., 125 volt, 1,600 r.p.m. exciter. A transmission line 4,200 ft. long connecting the power house with the mill transmits current at the generated voltage. It is then stepped down to 550 volts for motor operation. The motor equipment in the mill includes two 100 h.p., 3-phase, 60-cycle, 550 volt, 880 r.p.m. induction motors and one 30 h.p., 850 r.p.m. unit. The dam in connection with the power plant is 185 ft. long and 8 ft. high on the average. It is built of square timbers and bolted together with 1 in. Swede iron bolts spaced 4 ft. apart, the timbers being set on bed rock. Between the bolts two drift pins are used and the seams are calked. The joints between the ledge and the bottom of the dam are formed of concrete.

Edmonton, Alta.

The city of Edmonton is purchasing a 6,000 kw. turbo-generator unit. Mr. R. H. Parsons is superintendent of the power plant.

At the annual meeting of the Edmonton Interurban Railway Company a number of extensions were discussed and will likely be made during the coming summer. The most probable extension is a branch line along the north city limits to the Fort trail and on to Fort Saskatchewan.

Englehart, Ont.

Steps are being taken towards the installation of a street lighting system.

Galt, Ont.

The town of Galt have just completed the installation of a fine ornamental lighting system on Oak Street. The wire is underground in conduit. The poles are staggered chiefly on account of the quantity of shade trees on this street. Jandus pressed steel luxolabra, each carrying single tungsten units in spherical globes, are used throughout. This same standard as is now being adapted for the new nitrogen filled lamps. The standards were supplied by Messrs. R. E. T. Pringle.

Halifax, N.S.

The Canadian Provincial Power Company, Limited, have applied for incorporation. It is the intention of this company to develop power at East River, Sheet Harbour, and transmit it to the districts of New Glasgow and Truro. The New Glasgow line will be the principal one as it is the main industrial centre of the province. The main line to New Glasgow will be 48 miles long and at a point 22 miles from the power house a branch 33 miles long will be run out to Truro. At this point there is 16,000 h.p. available twelve hours in the day with almost perfect storage facilities. The plan calls for two power houses three miles apart, the upper under a 95-foot head and the lower under a 105-foot head. The incorporators of the company are H. G. Grant, ex-mayor Underwood, D. C. Sinclair, K. R. McKinnon, O. P. Fraser and W. C. McDonald.

Hedley, B.C.

The Daly Reduction Company, of Hedley, will install a hydro-electric power plant in Hedley. The equipment will consist of a 1500 h.p. water turbine, one waterwheel governor, one 1250 kv.a. generator with switchboard for same. Three miles of wire will be required for distributing system. George McEachern is engineer-in-charge.

London, Ont.

A very enthusiastic meeting of the hydro-electric radial delegates was held in London, on March 5th. The meeting was addressed by a number of the delegates, including Mr. J. W. Lyon, of Guelph, and the Hon. Adam Beck. It was urged that a monster deputation proceed to Ottawa in the very near future to use their influence with the Dominion Government to subsidize hydro railways, and to place the power on the Welland Canal available for their operation. It is likely steps will be taken to this end in the near future.

The 1914 estimates of the London Hydro-electric Commission include expenditures for sub-station equipment, for wires, cable and street lighting fixtures.

Lumsden, Sask.

As a result of an explosion of the compressed air tanks used for starting the engines in the electric plant at Lumsden, the system was out of commission for some time.

Lethbridge, Alta.

It is probable the street railway system will be extended during the present year to Hardieville. A by-law will be submitted to the rate payers asking authority to make the necessary expenditures.

Moncton, N.B.

Plans are being prepared for a street lighting system.

Montreal, Que.

At the annual meeting of the Cedars Rapids Manufacturing and Power Company, held in Montreal on March 5, the board of directors was re-elected as follows: J. E. Aldred, president; Howard Murray, vice-president; J. S. Norris, secretary-treasurer; J. C. Smith, R. M. Wilson.

The Outremont, P.Q., Council have awarded contracts for cables in connection with the scheme for town lighting designed by Professor L. Herdt. The Eugene F. Phillips Electrical Works, Limited, Montreal, received the contract for the armoured and lead sheathed cable, while the Imperial Wire and Cable Company were awarded the contract for 450 terminals at $7 each.

The Court of King's Bench, Montreal, has dismissed an appeal of the Montreal Tramways Company from the decision of the Quebec Public Utilities Commission ordering them to give details of the working of their company. The contention of the company was that the Commission had no jurisdiction, but the Court held that the Commission had ample powers under the Act.

According to a report from Quebec, an attempt is being made to revive the International Telephone Company, an independent concern organized by local men. Many thousand dollars were expended in constructing conduits and laying cables in the streets of Quebec, but operations were suspended three years ago owing to lack of capital. It is proposed to reorganize the company.

In the official notice confirming the amalgamation of the Northern Electric and Manufacturing Company, Limited, and the Imperial Wire and Cable Company, Limited, under the name of the Northern Electric Company, Limited, the directors state the present managements will be continued, but that there will be centralization with a view to effecting economies in administration. The officers are: Mr. E. F. Sise, president; Mr. Paul F. Sise, vice-president and general manager; Mr. Clement Sare, secretary, and Mr. G. W. Jones, treasurer. The fourth annual Montreal sales conference was held on February 25, 26, and 27, when there were talks and discussions on general sales principles and on specialties handled by the company. On the 27th a dinner was held at the St. Regis Hotel at which many out of town guests were present.

Montreal West, P.Q.

The town council of Montreal West, P.Q., have under consideration a street lighting system.

Ottawa, Ont.

The Ottawa & St. Lawrence Railway Company have made a request for a government subsidy to their railway lines passing the Rifle Ranges.

It is understood that a charter will be applied for, by private interests, to build an electric radial line from London to Grand Bend to Stratford. It is also said that the ultimate plans include Woodstock, Guelph, Galt, Toronto, and St. Catharines. This line would cover much the same territory as some of the lines projected by the municipalities and to be built by the Hydro-electric Power Commission of Ontario.

The past year was a very successful one for the Ottawa Light, Heat and Power Company. At the annual meeting of the shareholders, which was held a few days ago, the financial statement, submitted by the President, Mr. Thomas Ahearn, showed that the gross revenues were $834,662.31, an increase over the previous year of $54,688.97. The net surplus of revenue over expenditures, including bond and bank interest, was $297,766.93. During the year the sum of $808,331.80 was spent from the capital account on additions and improvements to the plants of the Ottawa Electric and Ottawa Gas Companies, the two concerns which form the Ottawa Light, Heat and Power Company. After paying four quarterly dividends at the rate of eight per cent. per annum, with two bonuses of 1 per cent., $90,000 was carried over to the reserve account. The assets of the company are now placed at $5,294,406.87. The following board of directors was re-elected: President, Thomas Ahearn; vice-president, E. H. Bronson; secretary-treasurer, D. R. Street; directors, Travers Lewis, K.C., John Manuel, James Manuel, C. J. McCuaig, Honore Robillard and Warren Y. Soper.

Port Arthur, Ont.

The city will apply to the provincial legislature for power to extend the street railway system into the townships of McIntyre, Gorham and Ware.

Peterborough, Ont.

The plans of the Peterborough Radial Railway System for the present summer include considerable extensions, paving work and increases in the rolling stock.

Regina, Sask.

The operation returns of the municipal street railway system for the week ending February 21 were as follows: Revenue, $4,132; passengers carried, 98,984; passengers carried including transfers, 110,927. For week ending February 28 corresponding figures were $3,951.10; 95,916 and 107,582.

By-laws were submitted on March 11 as follows: $240,000 for completing the construction of the electric light and power plant and the construction of the building in connection therewith and for acquiring necessary additional equipment; $160,000 to be expended in the purchase of a motor-converter, meters, transformers, etc.

Saskatoon, Sask.

A by-law has been passed by the city council giving the city electrical engineer power to insist upon all electric wiring and installations being in accordance with standard rule.

The generating plant of the municipal system has been temporarily out of commission. The street railway system was entirely tied up and the lighting system very much crippled.

The city commissioners have decided that they will not install any more tungsten clusters for street illumination, the modern arcs being considered more satisfactory on account of greater efficiency.

Stellarton, N.S.

An offering of 5 per cent. bonds of the Pictou County Electric Company, Limited, is being made. The Pictou company possesses the right to operate an electric tramway and supply electric energy for light and power in Trenton, New Glasgow, Stellarton, Westville and in any part of Pictou County, N.S. The company now operates ten miles of tramway and supplies light to Trenton, New Glasgow, Westville and Stellarton.

St. Catharines, Ont.

Following the successful conference in London re hydro-radials it is suggested that a similar conference be held with St. Catharines as the place of meeting at which delegates from Lincoln, Welland and Wentworth counties may gather to discuss the same question.

St. Thomas, Ont.

The offer of the London & Lake Erie Railway & Transportation Company to complete extensions from St. Thomas to Aylmer and from Union to Sparta has been accepted by the interested municipalities who will guarantee the bonds of the company to the extent of $20,000 per mile.

Toronto, Ont.

Construction work has begun on a new factory for the Canada Wire & Cable Company at Leaside.

The Hydro-electric Power Commission of Ontario have lodged a formal protest against the passage of the Bill of the Niagara-Welland Power Company which is asking authority to develop water powers along the new Welland canal.

A large meter contract has been awarded to the Canadian Westinghouse Company by the Ontario Hydro-electric Power Commission. It is the intention to supply municipalities through the Commission, the idea being that a lower rate will be obtained in this way.

The Public Service Commission of New York State have approved the application of the Canadian-American Power Corporation to engage in the business of electric power distribution. This company has available 46,000 h.p. which it has purchased from the Toronto Power Company for export.

Uxbridge, Ont.

The Home Independent Telephone Company will buy out the lines of the Uxbridge and Scott Telephone Company.

Vernon, B.C.

An electric light by-law authorizing the expenditure of $14,000 was recently passed.

Waubaushene, Ont.

The village of Waubaushene have passed a by-law under which they agree to take 25 h.p. of electric energy from the Hydro-electric Power Commission of Ontario. This village is the closest customer to the Big Chute water power development and the rate will thus be very low. Practically the only industries in Waubashene at the present time are the saw-mills and these develop their own power using sawdust and other by-products as fuel. It is very possible that under the rates that can be given with hydro-electric the private plants will be shut down.

Winnipeg, Man.

Contracts have been awarded by the Board of Control for transformers as follows: Single-phase, pole type transformer, Canadian Westinghouse Company; three-phase pole type transformers, Canadian Moloney Company; single-phase and three-phase subway transformers, Mercer & Essex Terminal.

Commissioner Robson will order that all cars to be built in future for the Winnipeg Electric Railway Company must be of the pay-as-you-enter type. Also the company will arrange in future to have their cars stop on the near side of the street.

Westmount, P.Q.

The city council of Westmount, P.Q., have passed a by-law to borrow $250,000 for improving the lighting system and for placing all wires in underground conduits. The city recently installed on Western Avenue 50 6.6 ampere magnetite arc lamps supplied by the Canadian General Electric Company, the system being described in the Electrical News of January 1st. The lighting has proved so satisfactory that an additional 100 standards have been ordered, and these will be placed on Sherbrooke Street and a portion of St. Catharine Street. The sum to be borrowed will enable the council to instal the lights on all residential streets and also to place all the wires underground. Provided the proprietors sanction the by-law, a portion of the work will be carried out this year. The city own the lighting plant, and it is stated that the profits will be sufficient to pay all charges on the bonds to be issued.

Lighting Schedule for April, 1914

Courtesy of the National Carbon Company, Cleveland.

Date.	Light.	Date.	Extinguish.	No. of Hours
Apr. 1	11 10	Apr. 2	5 00	5 50
3	0 00	3	5 00	5 00
4	0 50	4	4 50	4 00
5	1 30	5	4 50	3 20
6	2 00	6	4 50	2 50
7	2 30	7	4 50	2 20
8	No Light	8	No Light	
9	No Light	9	No Light	
10	No Light	10	No Light	
11	7 00	11	10 00	3 00
12	7 00	12	11 20	4 20
13	7 10	14	0 40	5 30
14	7 10	15	1 50	6 40
15	7 10	16	2 40	7 30
16	7 10	17	3 20	8 10
17	7 10	18	3 50	8 40
18	7 10	19	4 30	9 20
19	7 10	20	4 30	9 20
20	7 10	21	4 30	9 20
21	7 10	22	4 30	9 20
22	7 10	23	4 30	9 20
23	7 20	24	4 20	9 00
24	7 20	25	4 20	9 00
25	7 20	26	4 20	9 00
26	7 20	27	4 20	9 00
27	7 20	28	4 20	9 00
28	7 20	29	4 20	9 00
29	10 00	30	4 20	6 20
30	10 50	May 1	4 10	5 20

Total Hours............179 30

Wm. Wurdack Electric Mfg. Co.

19 to 23 South Eleventh St., St. Louis, Missouri

Manufacturers of

Switchboards — Panelboards — Cabinets, Etc.

We are in position to make up your special requirements at a low cost—Write us for prices before placing your next order.

Condensed Department

Publisher's Notice

Advertisements under "Situation Wanted" "Situation Vacant" or Miscellaneous, are charged at 2 cents a word per insertion, minimum charge 50 cents.

Advertisements for tenders, equipment, wanted or for sale, etc., are charged at $2.10 per inch.

All advertisements must be in the publisher's hands by the 10th or 23rd of the month to insure insertion in the subsequent issue.

Town Engineer Wanted

Town of Melville, Saskatchewan

Applications will be received by the undersigned until six p.m., **Monday, March 16th, 1914**, for the position of engineer for the Town of Melville. Applicants will please give details of experience in sewage installation and other branches of work, and state salary required.

By order,
FRED. H. CLARKSON,
Town Clerk.

5-6

CITY OF REGINA

Sealed tenders, registered and clearly marked on the outside of the envelope, "Tender on Generating or Distributing Equipment for the Electrical Department," and addressed to the City Commissioners at Regina, Saskatchewan, will be received up until noon of March 28th, 1914, for the supply of:—

Generating Equipment

Item 1—Station switchboard consisting of two exciter panels, six generator panels, one totalling panel and sixteen feeder panels.
" 2—Six three phase, feeder regulators.
" 3—One motor-driven exciter, 125 kw.
" 4—One geared turbine-driven exciter, 125 kw., electrical end speed not over 900 r.p.m.

Distributing Equipment

Item 1—Weather-proof copper wire.
" 2—Insulators, top pins, etc.
" 3—Cross-arms.
" 4—Pole line hardware.
" 5—Cedar poles.
" 6—Pole type transformers.
" 7—Street lighting equipment.
" 8—Cut-out mast arms.
" 9—Integrating wattmeters.

Prices to be f.o.b. Regina.

Copy of specifications may be obtained from E. W. Bull, Superintendent of Light and Power, Regina, Sask.

A marked cheque for 5 per cent. of the amount of tender price to accompany tender.

The City Commissioners reserve the right to reject any or all tenders.

5-6 Superintendent of Light and Power Dept.

Machinery For Sale

Electric Dynamos, transformers and meters for sale:

One 5-kw. transformer (Westinghouse, type N), 60 cycles.

One 5-kw. transformer (Westinghouse, type C), 60 cycles.

Two 5-kw. transformers (Packard, type R), 60 cycles.

Three 5-kw. transformers (Rideau) 60 cycles.

One 5-kw. transformer (Newark), 133 cycles.

One ½-kw. transformer (American), 133 cycles.

All above 2,000 100 volts—complete with hangers

Fifty 5-amp. Westinghouse wattmeters (60 or 125 cycles) glass case.

Thirty 5-amp. Gutman wattmeters, 133 cycles.

Six 10-amp. Gutman wattmeters, 133 cycles.

One 20-amp. Gutman wattmeter, 133 cycles.

One 30 kw. S. K. C. Generator, 2-phase, 2,200 volts; complete with exciter and switchboard.

One 30-light Ball arc dynamo with switchboard.

Apply for particulars to W. R. Reynolds, Supt. of Construction, Forest, Ont. 6

Situations Vacant

WANTED By large Electric Service undertaking in Canada, Sales Manager to take care of business-getting under the General Manager. Apply stating age, experience and salary required to John Mackay & Company, Toronto General Trusts Building, 85 Bay Street, Toronto. 6

WANTED—Qualified accountant to take charge of branch of Accounting Department of large Canadian Electric Service Corporation. Knowledge of the business essential. Liberal salary to good man. Apply in writing, stating age, experience and salary required to John Mackay & Company, Toronto General Trusts Building, 85 Bay Street, Toronto. 6

Situations Wanted

Young man 23, desires position as travelling salesman to some electrical firm. Six years electrical experience, two years road experience, best of references. Box 981, Electrical News. 6

ELECTRICAL ENGINEER

Position Wanted.—Electrical Engineer, expert in erection and repair of a.c. and d.c. power apparatus with good practical experience and graduate of well-known college is open for a position. Can furnish references from well-known Canadian firms as to erections formerly made. Apply Box 982, Electrical News, Toronto. 6

ELECTRICIAN

Young man desires change; unmarried; experience in operating in power and sub-stations, switchboard wiring, motor maintenance and general electric work in light and power stations. First class lineman. Best of references. Box 980, Electrical News, Toronto. 6

SECOND HAND ELECTRICAL MACHINERY

Bought, sold, rented, and exchanged. We have the largest stock in America. Send for our monthly bargain sheet showing complete stock with our prices.

GREGORY ELECTRIC CO.
CHICAGO, ILLINOIS
Established 1893

GALVANIZING
HOT PROCESS

We use Prime Western Spelter and we Galvanize to Western Union standard specification.

QUEEN CITY GALVANIZING WORKS
5 Wabash Ave., off Sorauren Ave. N.
Toronto

Electrical Machinery

Motors, Dynamos, Generators,
Electrical Pumps and Supplies.
Electrical Contractors.
Motor Repairs.

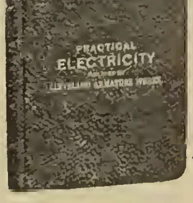
MAC ELECTRIC CO

52 Queen Street - OTTAWA

ELECTRICAL MACHINERY
AND REPAIRS

Armatures Complete
Armatures Rewound
Armature Coils
Armature Shafts
Field Coils

Commutators New,
Refilled or Assembled



Every electrician should have a copy of this book.
Price - $2.00
delivered

CLEVELAND ARMATURE WORKS, Cleveland, Ohio

MICA

KENT BROTHERS
Kingston, Ont., Canada

Miners, Exporters and Dealers in Canadian Amber Mica.
Thumb Trimmed, Cut to Size, Splittings, Discs, Washers, Etc.

Write us for prices and let us figure on your requirements.

The WESTON SYNCHROSCOPE

Constitutes a very simple and absolute *perfect solution* of problems involved in coupling alternating-current machines in parallel without danger or sensible disturbance of circuit conditions.

The indications are infallible.

There is only one object to observe.

The movement of the pointer is smooth and certain; it inspires confidence.

It indicates exact synchronism within 1 deg. of true phase coincidence over a wide range of frequency and voltage.

Send for catalog giving full *description of this unique instrument* and also our full line of A. C. and D. C. instruments for Switchboard, Portable and Laboratory Work.

Demonstrations of the operative characteristics of these remarkable instruments may be observed in our New York Office and also in the offices of Selling Representatives in Philadelphia, Chicago, San Francisco and Toronto.

Weston Electrical Instrument Company,

Main Offices and Works
NEWARK, N. J.

New York, 114 Liberty St.
Chicago, 832 Monadnock Blk.
Boston, 176 Federal Street.
Philadelphia, 342 Mint Arcade.
Birmingham, American Trust Bldg.

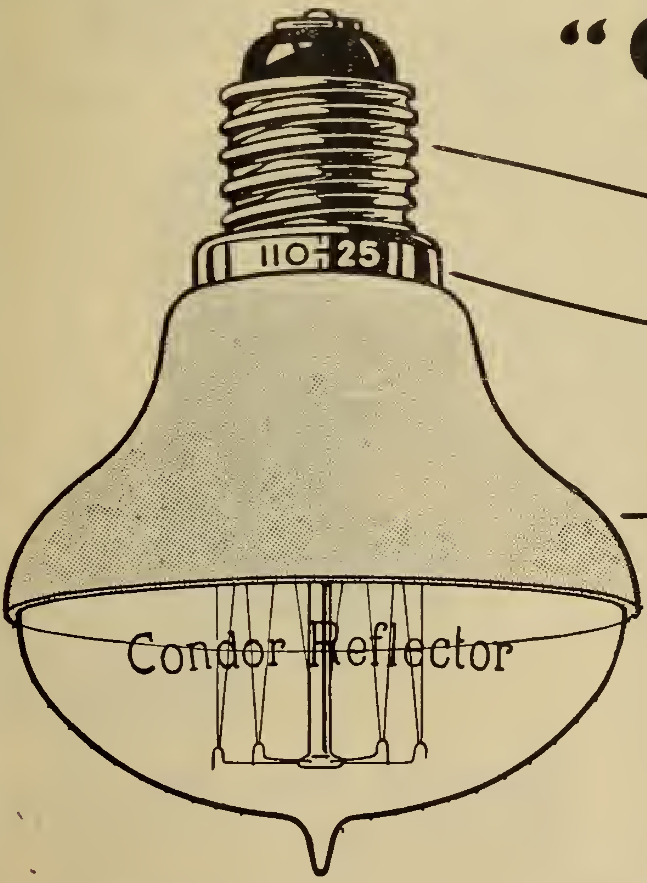
St. Louis, 915 Olive Street.
Denver, 231 15th Street.
San Francisco, 682 Mission St.
Cleveland, 1729 E. 12th Street.
Detroit, 618 Union Trust Bldg.

Montreal, Winnipeg, Vancouver, Calgary — Northern Electric Company, Limited
Toronto, 76 Bay Street.

London, Audrey House, Ely Place, Holborn.
Paris, 12 Rue St. George.
Berlin, Genest St. 5, Schoenberg
Johannesburg, So. Africa, F. Peabody Rice, Standard Bank Building, Harrison St.

"CONDOR"

Reflector Lamp



Edison Screw Base.

Brass bushing which may be unscrewed to release reflector.

Opal Reflector. This reflector is interchangeable, which, when the lamp burns out may be released and attached to new lamp.

One and a half candle power per watt.

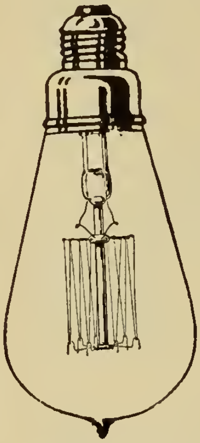
THIS IS STRICTLY NEW
(Canadian Patents applied for)

Get our prices now.

C. H. BASTERS & CO.
TORONTO, ONTARIO

Shuman-Wire Drawn Tungsten Lamps

You Should Sell Them



Think what it would mean if you could say "Here, Mr. Man, is a written guarantee for this Tungsten Lamp."

Stock **Shuman-Wire Drawn Tungsten Lamps** and you will sell a guaranteed article.

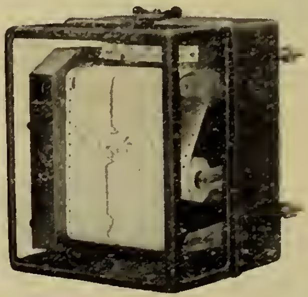
Full particulars of guarantee on application

Geo. H. Shuman Electric Co.
6th Floor Blumenthal Building
Montreal

Switchboard Indicating Meters

That Plot Curves

of amperes, volts, watts or speed.



A demand meter that not only gives the maximum but gives the load factor as well. There is nothing like the graphic instrument for checking consumer's power bills. Settle disputes by a curve in black and white showing power used by employees without the superintendent's knowledge.

This instrument gives a minute by minute record for a week. It is reliable, accurate and efficient.

Write today for book No. 3120.

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Engineers and Manufacturers
Indianapolis, Ind.

Here is Your Opportunity

Local Agents Wanted

Halifax, St. John, Quebec, Ottawa, Toronto, Winnipeg, Calgary, Edmonton and Vancouver

Tungsten Lamps,
Flash Lights,
Batteries and
Electric Specialties

Geo. H. Shuman Electric Co.
6th Floor Blumenthal Building,
MONTREAL

SAFETY FIRST

The Important Factor in Fare Collection

Satisfaction Guaranteed

Write for Catalog

Cleveland Fare Box Co.
5310 St. Clair Ave., Cleveland, Ohio

CUT GLASSWARE

No. 441 C 410

No. 496 C 206

No 439 C 400

EXPERT workmanship on our cut shades and globes brings out the artistic and pleasing brilliancy that is intended.

Our new catalog No. 3 shows most of the standard cuttings.

Write for Catalog.

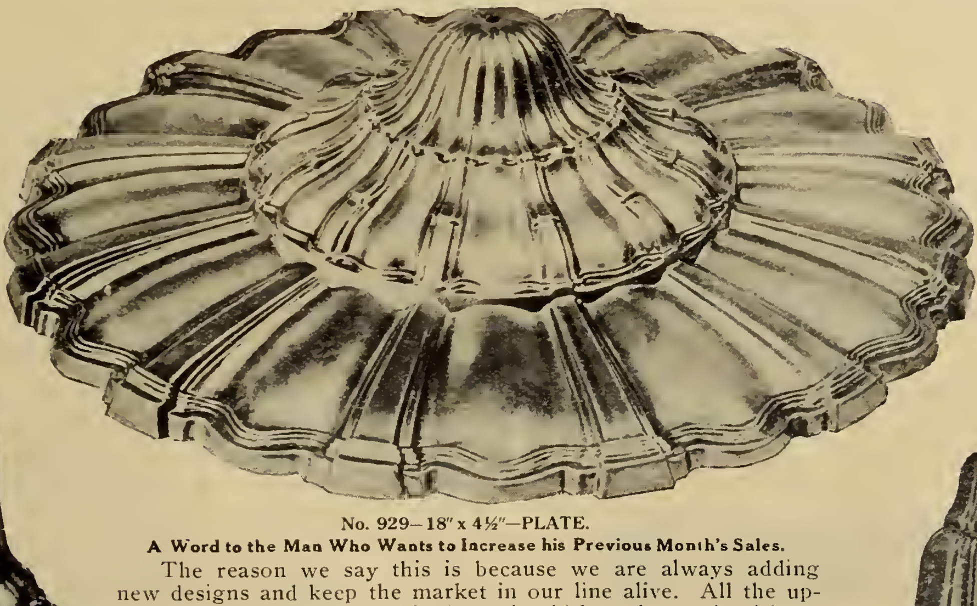
No. 1045 C 305.

No. 446 C 114

No 994 C 101

Jefferson Glass Co., Limited, Toronto, Ont.

EARLY ENGLISH DESIGN



No. 929—18″ x 4½″—PLATE.

CANOPY
No. 924,
5″ x 5″

CANOPY
No. 925,
2¼″ or 3¼″
Glass

A Word to the Man Who Wants to Increase his Previous Month's Sales.

The reason we say this is because we are always adding new designs and keep the market in our line alive. All the up-to-date manufacturers and jobbers should keep in touch with us.

We sell our products finished and unfinished. A trial will convince you that we are the right people to do business with. We are always making improvements in our factory, trying to increase the output in our line and make prompt shipments and with the co-operation of our customers we are sure you will make a success.

W. H. BANFIELD & SONS, 120 Adelaide St. W., TORONTO

Manufacturers of Electric Fixture Parts and Fittings.

We Have a Bell For Every Purpose

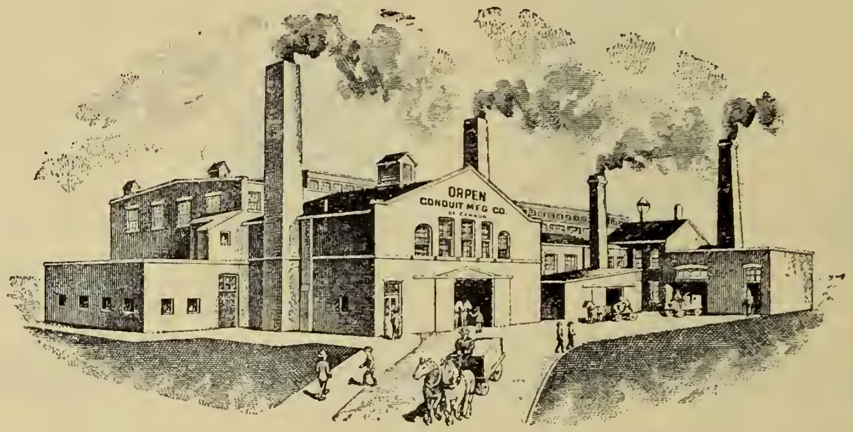
There can be only one best and that is the Schwarze. No. 12 Common Magneto Extension for telephone Service is illustrated herewith. The spools are large enough so that in no case is it necessary to use over No. 35 magnet wire, thereby obtaining the maximum number of ampere turns, and this wire is all active. Armature is under influence of coils its entire length. Poles arranged so that permanent magnet cannot be discharged, and will not weaken.

No. 13, same as No. 12, except larger and very much louder, and is for signalling purposes on high tension 60 cycle. Fully approved by Underwriters.

All weatherproof. Write for catalogue. All resistances.

Schwarze Electric Co., Adrian, Michigan
Norton Telephone Co., Canadian Agents

The home of
XCELADUCT
and
ORPENITE
CONDUITS


ORPEN CONDUIT MFG CO. OF CANADA

Queen
and
Dufferin
Streets
TORONTO

"XCELADUCT"

INTERIOR

"Xceladuct" is a high grade of galvanized conduit made of easy-bending spellarized steel tubing, doubly protected against rust by copper plating and zinc coating. Every length is made up with clean threads and smooth enameled interior, allowing easy and rapid fishing.

Orpen Conduit Manufacturing Co. of Canada
Manufacturers of
Xceladuct
and
Orpenite
Conduits
Head Office
Toronto Ontario

Let us send
Prices and Samples

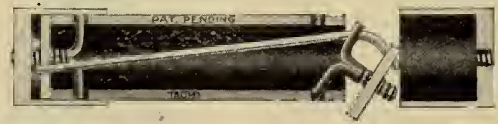
"ORPENITE CONDUITS"

CONDUITS

"Orpenite" Enameled Conduit is made of easy-bending spellarized steel tubing which is protected against rust and proof against all temperature conditions by coatings of specially prepared enamel. Each length presents clean threads and a smooth interior permitting of easy and rapid fishing.

THE ORPEN CONDUIT MANUFACTURING COMPANY of CANADA
TORONTO MONTREAL

DAUM REFILLABLE FUSES



Refilled by simply bending the fuse over the metal cross piece and screwing the cap in place.

No threads on the fibre tube to strip off or screws, rivets or clamps to get loose. Merely two holes in the fibre tube and held in place by the cap. This metal to metal contact is not affected by the swelling or shrinking of the fibre shell.

Daum Fuses are making good every day.

CATALOGUE NO. 17 for the asking

Sole Manufacturers
A. F. DAUM COMPANY, PITTSBURGH, PA.

DOSSERT CONNECTORS

have been recently referred to by the chief executive of a great Edison Company as good examples of the genius of DOING AN ORDINARY THING IN AN EXTRAORDINARY WAY. Joints made up in the Dossert way are simple and good electrically and mechanically. They effect extraordinary economies in labor and materials and never fail when subjected to overloads that would cause burnouts in soldered joints.

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H. B. LOGAN, PRESIDENT
IRVING SMITH. Canadian Rep., Unity Bldg., MONTREAL

John Starr, Son & Co.
Limited
158 Granville St. - HALIFAX, N. S.

Electric Lighting Supplies

LAMPS, SOCKETS, ROSETTES, WIRES, CORDS, CONDUIT, MOULDING, SWITCHES, CUT-OUTS, FIXTURES, ETC., ETC.

Large Stocks - Prompt Shipments

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You Eliminate Needless Risk

when you install STANDARD Rubber Insulated Wire in that building of yours. Its guarantee of safety consists of many years of unusually successful and dependable service and in the fact that it is specified and used by architects, engineers and contractors of many buildings of international importance, one of which is shown below.

STANDARD Rubber Insulated Wire

stands for maximum economy and durability. It exceeds N. E. C. requirements to a degree that entitles it to be considered as a separate and *higher* standard of excellence.

Get prices of STANDARD *wire from our nearest office before you buy.*

Fort Garry Hotel,
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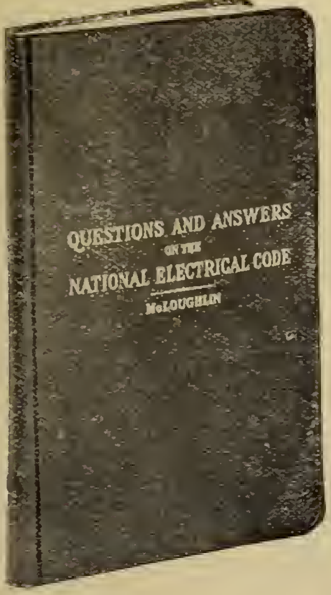
Architects:
Ross & McDonald,
Montreal, Que.
El. Contractors:
L.H. Nielson Co. Inc.
Pittsburgh, Pa.

Standard Underground Cable Co. of Canada, Limited
Hamilton, Ont.

Montreal, Que.
Boston, Mass.
Winnipeg, Man.
Seattle, Wash.

You Can Interpret the Code Instantly with McLoughlin's

Questions and Answers on the National Electrical Code



It tells at once the answer to the questions on code requirements. Contractors, electricians and wiremen write us that it hits the mark for them. It saves them time, trouble and real money.
Every question is carefully indexed so that you can locate the fact you are after instantly.
Contents—There are nine main divisions: Generators, Transformers, Outside Works, Signaling Systems, Lighting, Inside Works, Electric Railway Systems, Marine Work.
Tables—Section 9 has 32 tables. They give in convenient form for ready reference: Capacities of wires; Wire requirements for all classes of work; Insulation Tests; Requirements for Conduit Wires; Flexible Cords; Fixture Wires; Theatre Cables; Elevator Cables, etc., etc.
The latest rules for Resuscitation are included.

232 pages, pocket size, flexible binding $1.00 net, prepaid.

For Sale by

Electrical News, - 220 King Street West, Toronto

"GOOD POLES QUICK"

for our Canadian customers means

British Columbia Cedar Poles

shipped from some one of our 14 pole yards in Canada. Our Canadian Stocks are by far the largest and most complete.

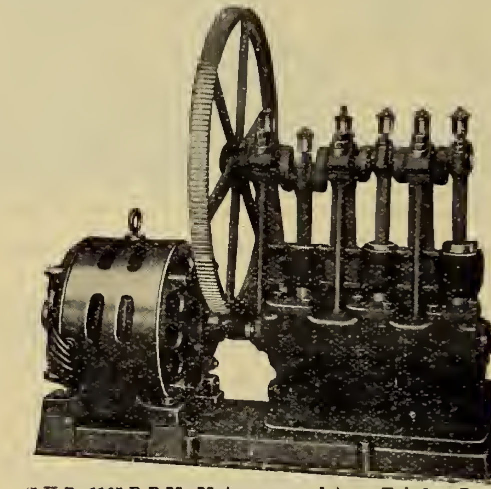
May we quote you?

The Lindsley Brothers Company
"Good Poles Quick"
Spokane — Chicago
Construction Supply Co., Toronto, Representatives
Frank E. Filer Winnipeg

Century

Single Phase Motors

develop such a heavy starting torque as to make them particularly desireable for the operation of pumps which have to be started under full head.



(5 H.P. 1165 R.P.M. Motor geared to a Triplex Pump).

In addition their construction is such as enables them to give continued satisfaction under geared service.
¼ to 40 Horse Power—25 to 140 cycles.

CENTURY ELECTRIC COMPANY
19th, Pine and Olive Sts., ST. LOUIS, Mo.

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Mainer Electric Co., Ltd. Winnipeg and Edmonton	Rankin & Cherrill 547 Main St., Vancouver

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A Text Book for Gift Makers

at any time is our new booklet,
"The Dainty Way to Keep House."

¶ It has interested thousands in lamp socket cooking and heating appliances of Simplex Quality.

¶ Your customers will be glad to receive it.

SIMPLEX ELECTRIC HEATING CO.
Mfrs. of Everything for Electric Heating and Cooking
BELLEVILLE, ONT.
CHICAGO, 15 S. Desplaines St. CAMBRIDGE, MASS.
SAN FRANCISCO, 612 Howard St.

Sparkless Commutation Demands

CERTAIN, DEFINITE BRUSH RESISTANCE

depending upon the design of the motor or generator. Further

A Definite Degree of Abrasiveness Is Necessary in Brushes

to keep the mica insulation of the commutator flush with the copper segments.

TUNGSTEN
Pure Carbon Brushes

are classified in an entirely new way which makes it easy to select the brush best suited to your service. We classify brushes with respect to voltage, current density, resistance per cubic inch and abrasiveness——the latter under seven divisions.

Pure Carbon Company
Wellsville, N. Y.

Toronto & Hamilton Electric Company

HAMILTON

Offer for sale the following

Second-Hand Motors

2—50 H.P. Type C. Westinghouse, 2 phase, 60 cycle, 220 volts, 900 Rev. Starter, rails and pulley.
1—20 H.P. Type C. Westinghouse, 2 phase, 60 cycle, 220 volts, 900 Rev. Starter, rails and pulley.
1—20 H.P. Type CCL Westinghouse, 2 phase, 60 cycle, 220 volts, Starter, rails and pulley, 1200 Rev.
1— 5 H.P. Type CCL Westinghouse, 2 phase, 60 cycle, 220 volts, 1800 Rev.
1— 1 H.P. Type CCL Westinghouse, 2 phase, 60 cycle, 220 volts, 1800 Rev.
1— 3 H.P. Type KQ C.G.E. 2 phase, 60 cycle, 220 volts, 1800 Rev.
2— 2 H.P. Type 1G C.G.E., 2 phase, 60 cycle, 220 volts, 1800 Rev.
6— 1 H.P. Type S T.H.E., 2 phase, 60 cycle, 220 volts, 1800 Rev.
4— 2 H.P. Type S T.H.E., 2 phase, 60 cycle, 220 volts, 1800 Rev.
2—10 H.P. Type S T.H.E., 2 phase, 60 cycle, 220 volts, 1800 Rev.
3—½ H.P. Type S T.H.E., 1 phase, 60 cycle, 110 volt, 1200 Rev.
2—½ H.P. Type A T.H.E., 1 phase, 60 cycle, 110 volt, 1200 Rev.

For further particulars address

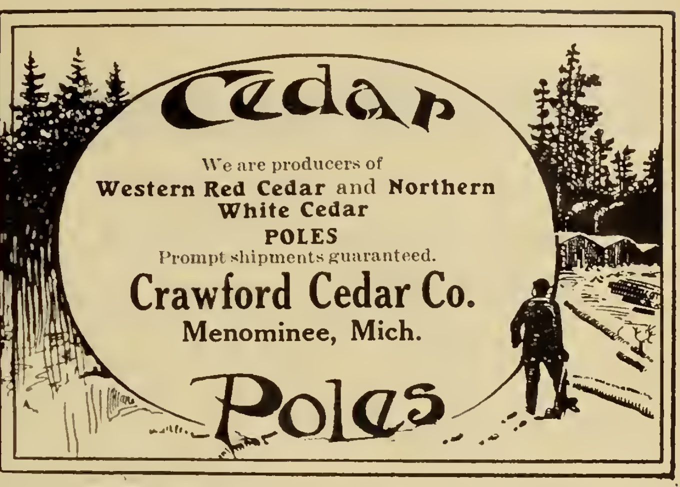
Toronto & Hamilton Electric Co.
HAMILTON, ONT.
—AGENTS FOR—
The Willard Storage Batteries.

NAUGLE **Pole & Tie Co.**

Main Office
5 South Wabash Ave.
Chicago, Illinois

We have yards in Canada guaranteeing our motto:
"SERVICE"
"PRICE" "QUALITY"
ONE QUALITY
ANY QUANTITY

POLES



Cedar

We are producers of
Western Red Cedar and Northern White Cedar
POLES
Prompt shipments guaranteed.

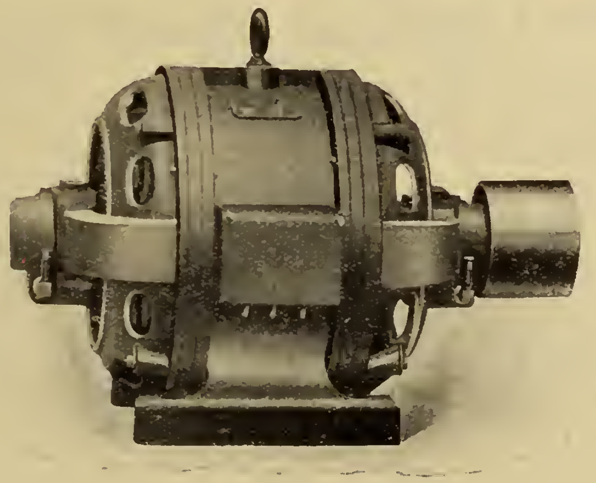
Crawford Cedar Co.
Menominee, Mich.

Poles

"UNION" Dynamos and Motors

For All Industrial Purposes

Estimates given for all special designs of motor and engine driven generator sets.



Write for our motor stock list published monthly and take advantage of our prompt deliveries.

Pattern H D Squirrel Cage Motor

Canadian Union Electric Co., Limited
Head Office: 130 Wellington St., West, Toronto
Also at 9 St. Nicholas St., Montreal

Represented in Winnipeg by:
The Mainer Electric Co., Limited
61-63 Albert St.

Yards from Maine to Washington.

Wire or write us for delivered prices.

Cedar Poles

National Pole Co.
Escanaba, Mich.

WESTERN LUMBER AND POLE CO

7 CEDAR POLE YARDS IN B. C.—7
For prices on B. C. Cedar Poles address
WESTERN LUMBER & POLE COMPANY
Main Office - DENVER, COLO.

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Mechanical

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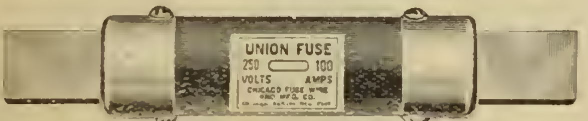

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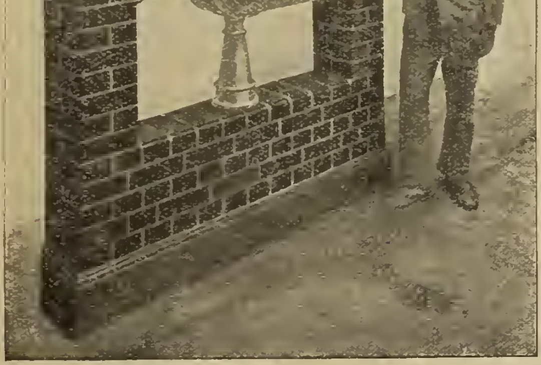

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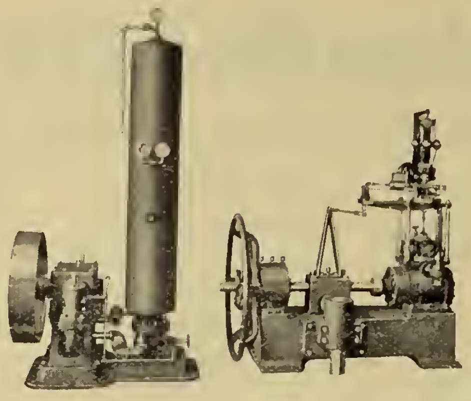

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We are specialists in the manufacture and application of hydraulic governing apparatus.

The knowledge and the shop equipment which enable us to build the 250,000 ft. lb. governors for the Mississippi River Power Co. at Keokuk, are at the command of the purchaser of any of our governors.

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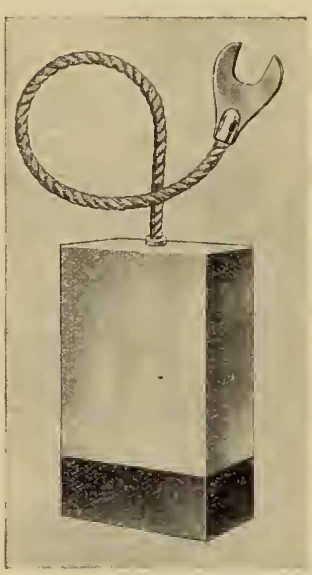

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Our B. B. special carbon brush is of the highest class. It is so blended and tempered that it has an extremely long life and the lubrication is positive through the life of the brush.

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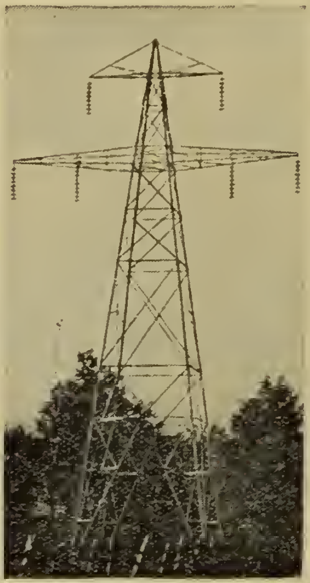

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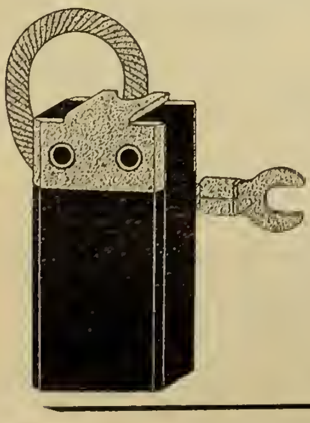

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Why experiment.
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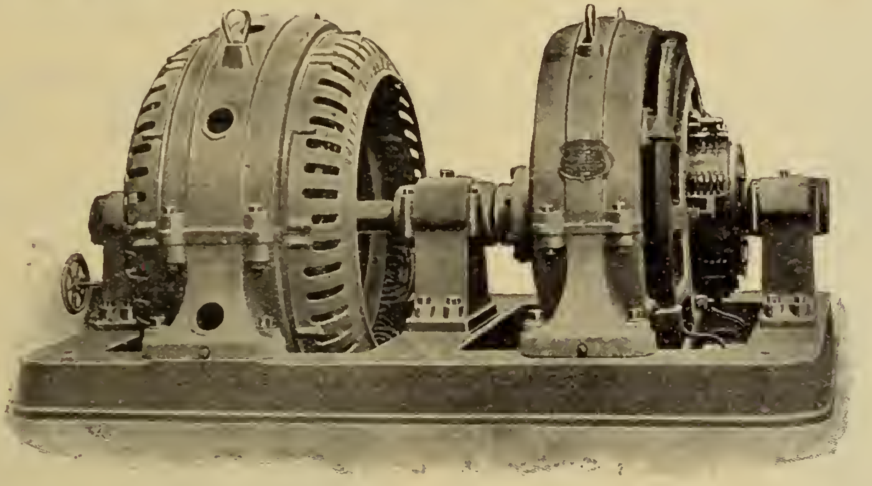
Curve Drawing Meters. Portable Type for Factory Use

The "Lancashire" Ball Bearing Induction Motor



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Motor Generator—300 K.W. for Traction Service.

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Send in that broken down machine and have us give you a price to make it good, nothing too small and nothing too big. You know the old slogan "A stitch in time saves nine" it holds good with your plant, a new coil dropped in your machine at the right time saves rewinding it.

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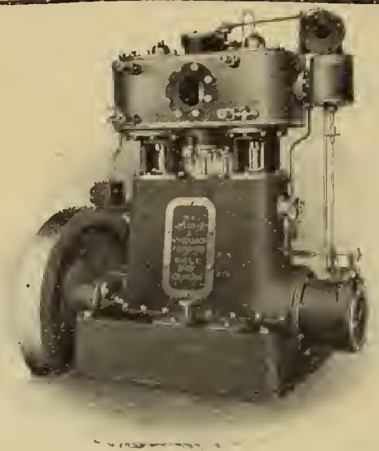

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With Combined Throttle and Expansion Governor

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All Engines are Tested under Steam before leaving our works

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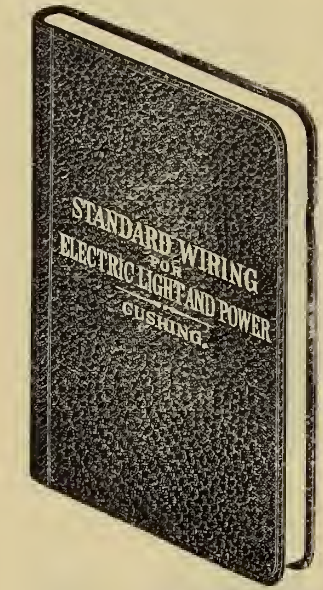

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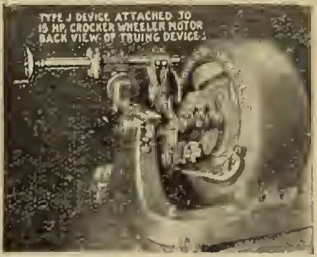
No large cuts from commutator and no unnecessary waste of copper.

No dragging of copper causing short circuits.

No portable slide-rest with the danger of the tool digging into the commutator and numerous other chances of damage to the commutator or armature which are all overcome with this machine.


TYPE J DEVICE ATTACHED TO
15 HP. CROCKER WHEELER MOTOR
BACK VIEW OF TRUING DEVICE

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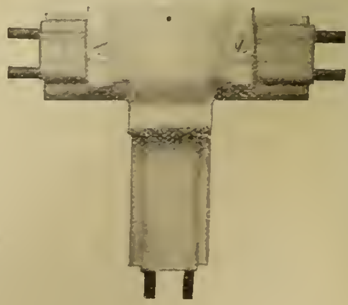
The Jordan Tapon for Moulding Work

A real time saver which means a Money Saver, making the best class of work.

It is not necessary to have the ends of the capping straight as the cover of the Tapon overlaps the capping, thereby covering any bad ends of capping.



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The Filament is ANNEALED. If you have handled wire, you will know that a hard wire breaks easy, that if you anneal it, it will not break. The Annealing is the secret of this lamp's unparalled lasting quality.

But you will find many lamps that *last* because they have been made tough at the expense of efficiency.

NOTE THIS—The efficiency of this lamp is 1.1 Watts per candle.
It is remarkably tough when you first get it.
It is tougher after 200 or 300 hours' run than when first put in service.
And it's LOW IN PRICE.

Where else can you get this combination?

Agents wanted everywhere. Write to-day, state your probable requirements during the ensuing year and get the exclusive rights for your town before the other fellow does. You can beat him in Price and Quality.

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The Electrical Maintenance and Repairs Co., Limited
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FOR ALL YOUR ELECTRICAL EQUIPMENTS

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"Mantel Type" ELECTRIC RADIATOR

SIZES—24" x 30"—3 lamps; 30" x 30"—4 lamps.

EVERY wide-awake contractor and electrical supply house should handle the "NATIONAL" Mantel Type Radiator. It's a winner and a money maker.

Made in standard sizes and finishes. We also manufacture a complete line of portable radiators and air heaters from 650 watts to 10,000 watts capacity in any voltage.

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There is a "NATIONAL" heater for every requirement

The National Electric Heating Co., Limited
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2 Pole Amp. 125 Volts.

Also made in other sizes.

This "Detroit" Entrance Switch is approved by the Hydro-Electric Power Commission of Ontario for entrance work.

Switch and Cut-out are enclosed in an iron box.
Switch is operated from the outside of the box.
Box may be sealed or locked shut.
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Write for Special Bulletin.

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McNAUGHTON McKAY ELECTRIC CO., LTD.
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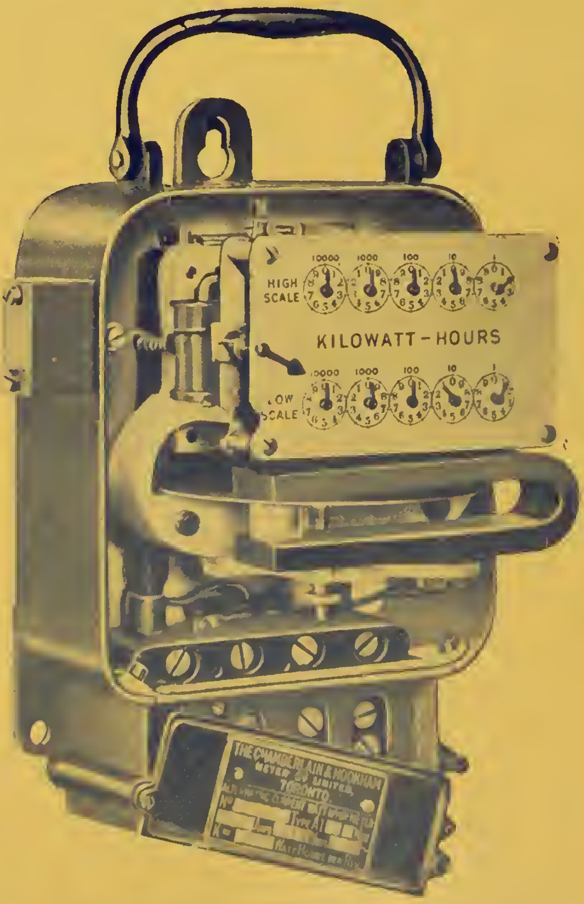
Detroit Fuse & Manufacturing Company
1404 Rivard St., DETROIT, MICH.



We illustrate here a C. & H. Two-Rate meter with clock dial. Note the rigid construction throughout.

We also carry a full stock of single, poly phase and prepayment meters.

How C & H Meters are made

First—QUALITY Of extreme importance in the manufacture of meters is the quality of material used. Nothing but "flawless" material is allowed to enter into the construction of C. & H. Meters.

Second—WORKMANSHIP Prominent, well known International meter specialists superintend the manufacture of C. & H. meters, which is done by skilled mechanics.

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SPENCER & ASPINALL
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Vol. XXIII—No. 7 Toronto, April 1, 1914

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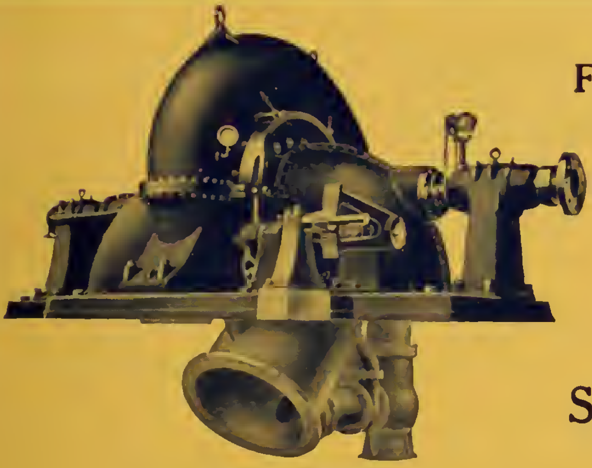
Generation, Transmission and Application of Electricity



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ECONOMY renewable cartridge FUSES

Made in Canada and sanctioned by the Canadian Fire Underwriters' Association.

SAFETY FIRST - - - - ECONOMY NEXT

Economy Fuses are safe under all conditions. They never hold a sustained arc nor vent fire. The only renewable fuse that is uniformly rated.

Eighty per cent. of annual fuse maintenance expense over the cost of using non-renewable fuses is saved when Economy Fuses are employed.

WRITE TO-DAY FOR BULLETINS, PRICES, AND DISCOUNTS.

Economy Fuse & Mfg. Co. of Canada, Limited, Herald Building Montreal

"Look for the Gray Shell"

Alphabetical Index to Advertisers, Page 8

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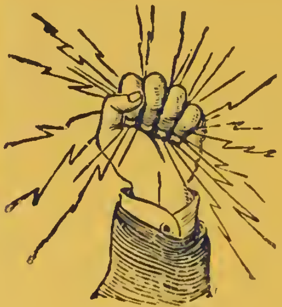

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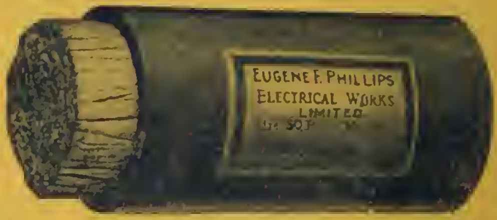

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Bare and Insulated Electric Wire and Cables for Aerial and Underground use

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Branches: Halifax, Toronto, Winnipeg,
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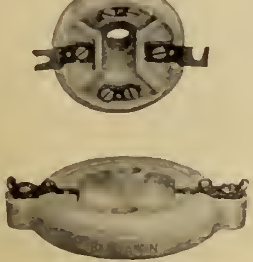
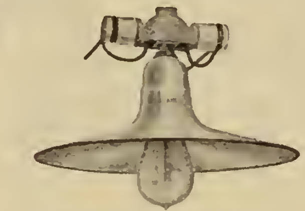


Cat. No. 870
Rosette



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is the

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Whether It Is a
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the factor of safety is first considered.

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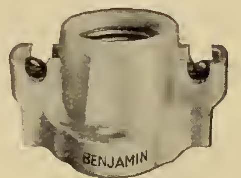
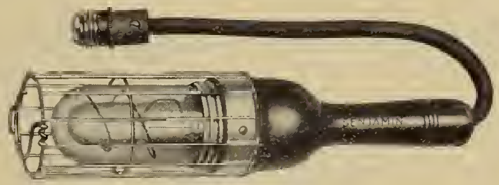


Cat. No. 59275
Receptacle

Cat. No. 61317
Porcelain Key Socket

Cat. No. 597
Angle Pull Socket

Cat. No. 1695
Switch and Cutout



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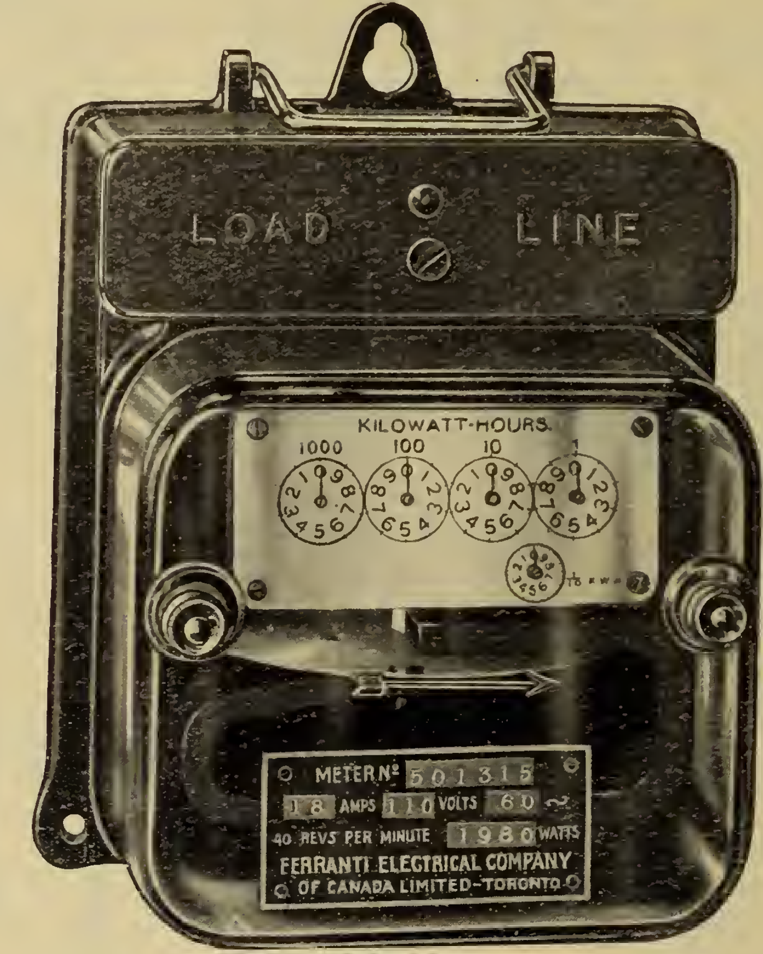
FERRANTI METERS

You can't beat 'em

ALWAYS RELIABLE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LINE
KILOWATT-HOURS
1000
100
10
1
METER Nº 501315
18 AMPS 110 VOLTS 60 ~
40 REVS PER MINUTE 1980 WATTS
FERRANTI ELECTRICAL COMPANY
OF CANADA LIMITED-TORONTO

NONE BETTER AT ANY PRICE

The illustration shows our Type "C" Single Phase Meter with glass case and clock dial.

The construction of this meter is such that each part is independently removable without disassembling the entire mechanism—an advantage found in no other meter on the market.

Our special low load adjustment insures accurate registration of the slightest current.

Our Type "C" Meter is furnished with glass or metal case, top or bottom connections and clock or cyclometer dials.

Get Our Prices—They Are Right.

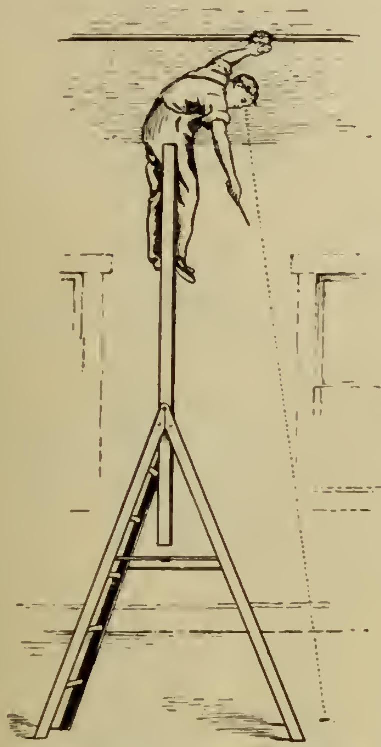
FERRANTI ELECTRICAL COMPANY OF CANADA LIMITED

90 Sherbourne St.
TORONTO

Farmer's Advocate Bldg.
WINNIPEG

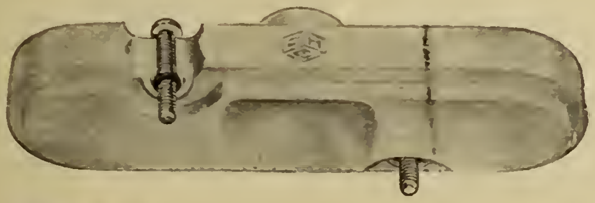
Screws That Can't Fall Out

Users of Condulets Lose No Time Picking Up Fastening Screws for Covers or Conduletto Fittings.



Couldn't Happen with a Condulet Cover

Brass Screws—the Proper Quantity, Size, Shape and Thread—are furnished with Condulet Covers and Conduletto Fittings, and are so secured in screw holes that they ***can't fall out.***



Screws for Porcelain Covers and Fittings are held in place by formed up fibre washers that engage the screw thread. Washer is put on after screw has been inserted in screw hole, and fits within cup made for it in the porcelain.

Screws for Metal Covers are necked just under the head, and screw holes in covers are tapped. When threading on screw has passed threading in hole, no shaking or knocks can make screw back out.

Screw for Porcelains

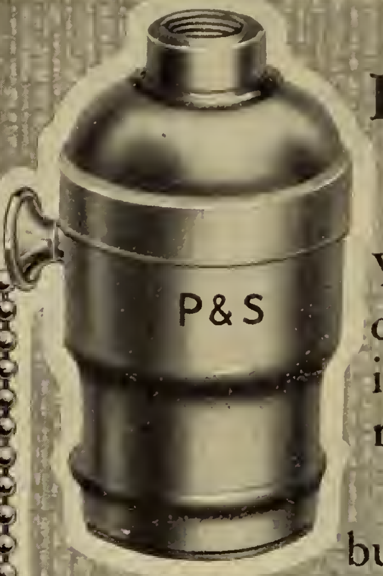
Screw for Metal Covers

NOTICE—This company has discontinued furnishing cover and fitting fastening screws with Condulets. These screws are now furnished with Condulet Covers and Conduletto Fittings for Condulets.

Crouse-Hinds Co. of Canada, Limited

Main Office and Works:

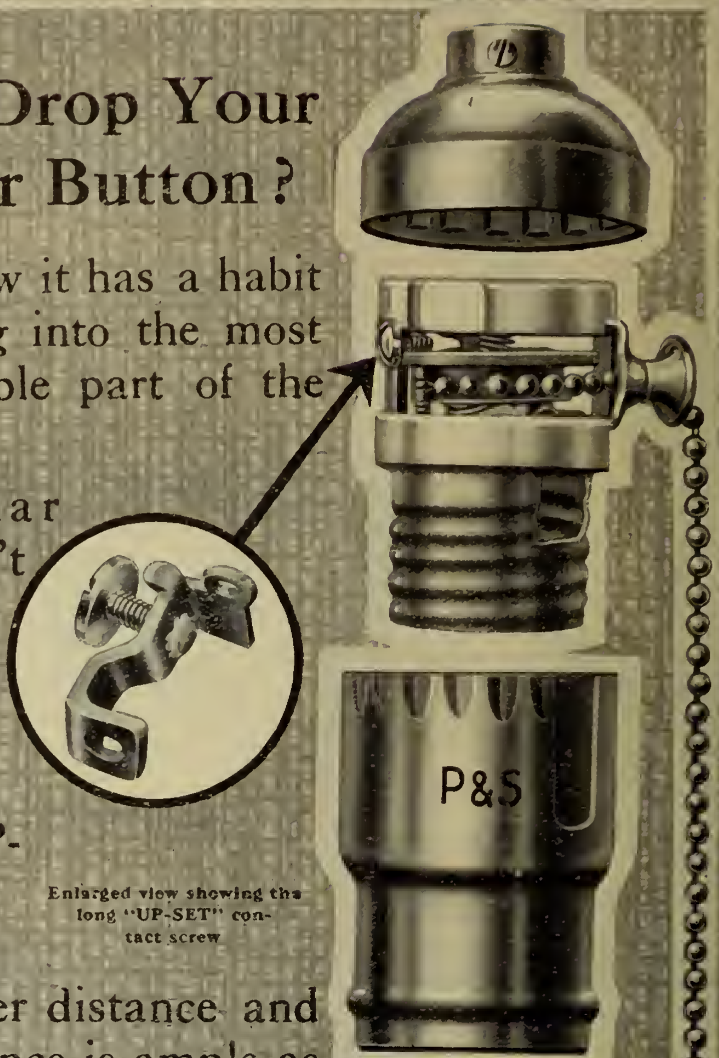
Toronto, Ontario, Canada



Ever Drop Your Collar Button?

You know it has a habit of rolling into the most inaccessible part of the room.

A collar button isn't in it with the ability of a small screw to get lost.



Enlarged view showing the long "UP-SET" contact screw

That is why P & S sockets have the "UP-SET" contact screws.

These contact screws can come out the proper distance and no further. This distance is ample as the screws are unusually long, in addition to being supplied with a large head.

Ask your workmen what they think about it

They know the time and temper lost in hunting about on the floor for small screws.

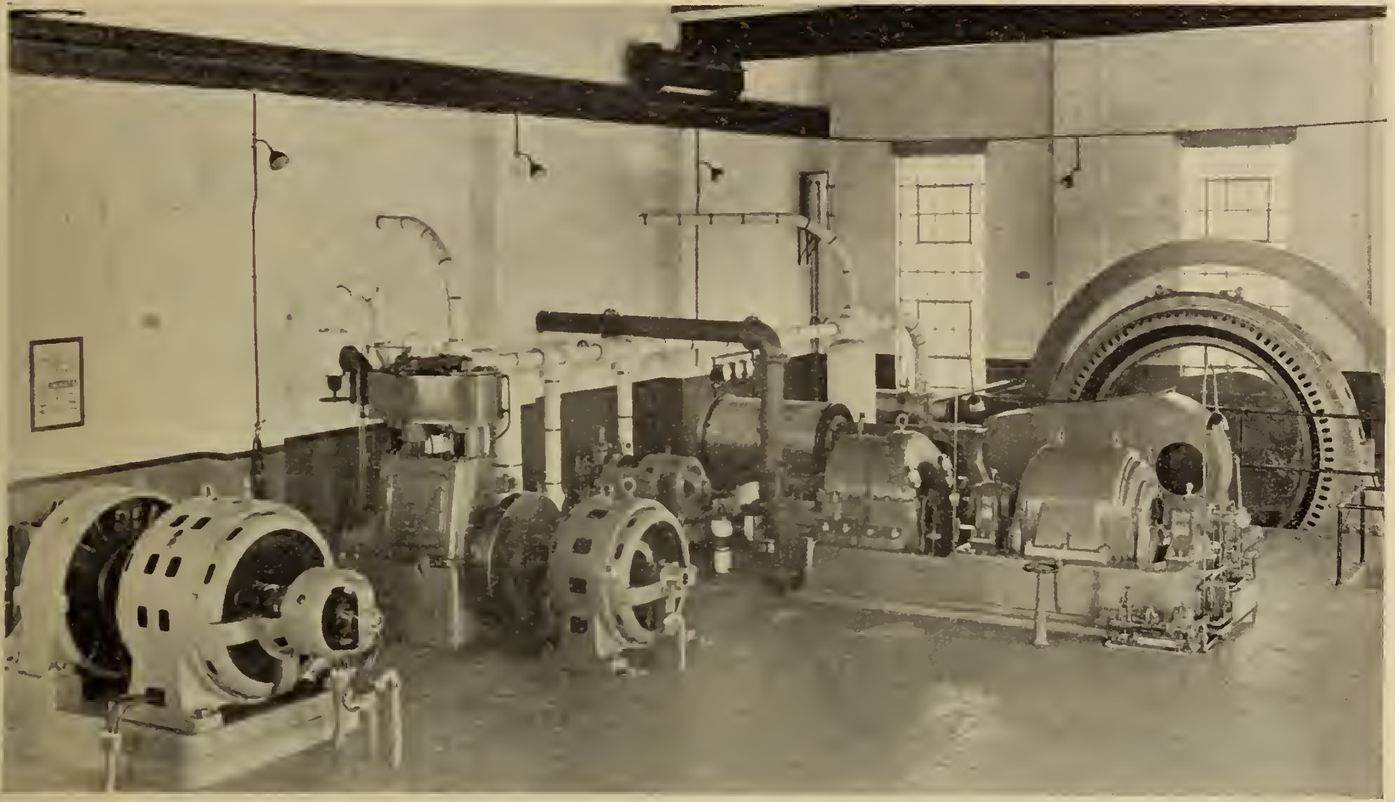
Order P & S Fluto Pull Sockets from your jobber thereby getting the sockets with the "UP-SET" screws.

Free sample gladly supplied on application to our nearest branch.

PASS & SEYMOUR, Inc.

MAIN OFFICE AND WORKS
SOLVAY, N. Y., U. S. A.

Pass & Seymour devices are carried in stock by all the leading Canadian Jobbers from Halifax to Vancouver.



New plant of Sarnia Gas & Electric Company.

The following apparatus was installed by
Swedish General Electric, Limited:

1—500 KVA, 3600 RPM, turbo-generator.
1—375 KVA, 100 RPM, engine type generator.
1—190 KVA, 450 RPM, engine type generator.
1—300 KW, 720 RPM, auto-synchronous motor generator set.
1—150 KW, 720 RPM, auto-synchronous motor generator set.
1—Eight panel switchboard.

THE SWEDISH GENERAL ELECTRIC, LIMITED

Head Office—TORONTO

Branch Offices—MONTREAL General Supplies Ltd., CALGARY, Alta.

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The Best Endorsement of the value of the "Electrical News" as an advertising medium is the above List of Advertisers

GALVADUCT

Shea's New Hippodrome, "A GALVADUCT" Building

LORICATED

"GALVADUCT"

The most perfect interior construction conduit on the market.
Recognized as the standard of high quality.

Always specify Galvaduct or Loricated conduits

"LORICATED"

A high-class interior construction conduit of the enamelled type, proof against acid or other corrosive agents.

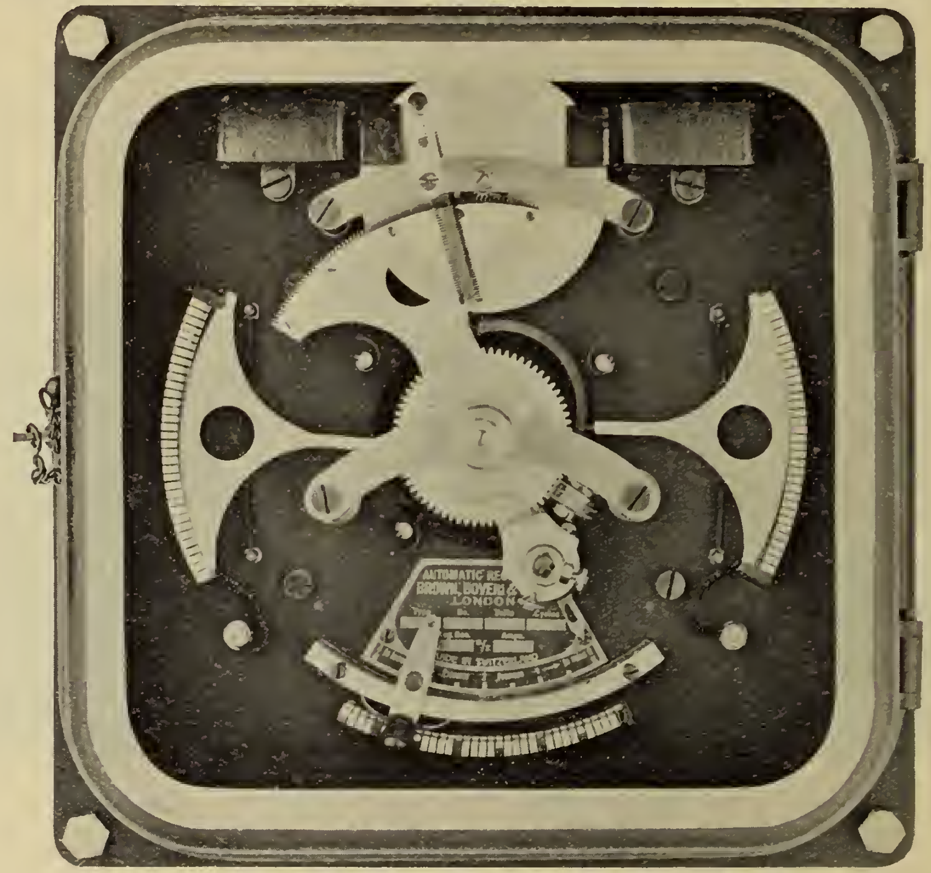
If your jobber cannot supply you—write us

USED IN THE FINEST BUILDINGS IN CANADA

Conduits Company Limited

Toronto - Montreal

BROWN BOVERI
AUTOMATIC VOLTAGE REGULATORS



Simple in Construction
Accurate in Regulation

Prompt in Action
Reliable in Service

Entirely without sliding or make and break contacts, and

Require No Attention

THOUSANDS ALREADY IN OPERATION

THE CANADIAN
CROCKER-WHEELER CO.
LIMITED
MANUFACTURERS AND ELECTRICAL ENGINEERS

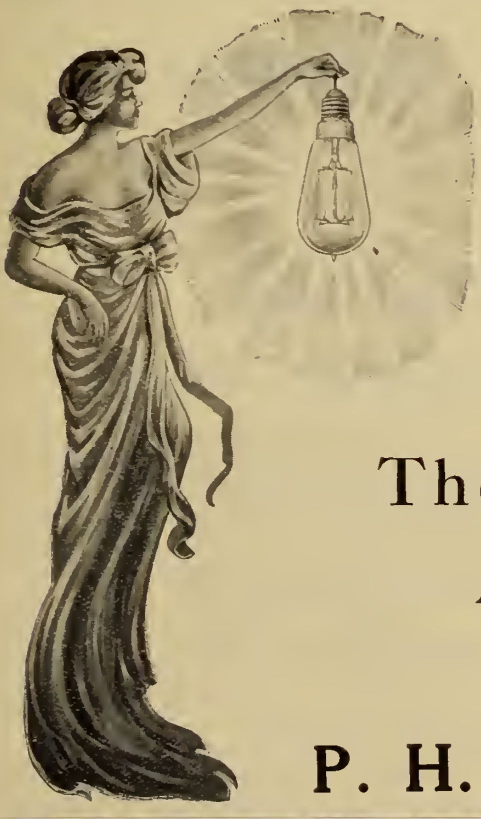
Head Office and Works
ST. CATHARINES

District Offices
MONTREAL, TORONTO, VANCOUVER

G. M. Gest

Conduit
Engineer & Contractor

503 Power Building, Montreal, Can.



NEWTYPE
BERGMANN
LAMPS
(*Tungsten Filament*)

The Unbreakable Kind

Are Now Ready for Delivery

We guarantee delivery to you in good condition

EXCLUSIVE CANADIAN DISTRIBUTORS

P. H. KLEIN CO., LIMITED
23-25 DOWD STREET,
MONTREAL, P.Q.

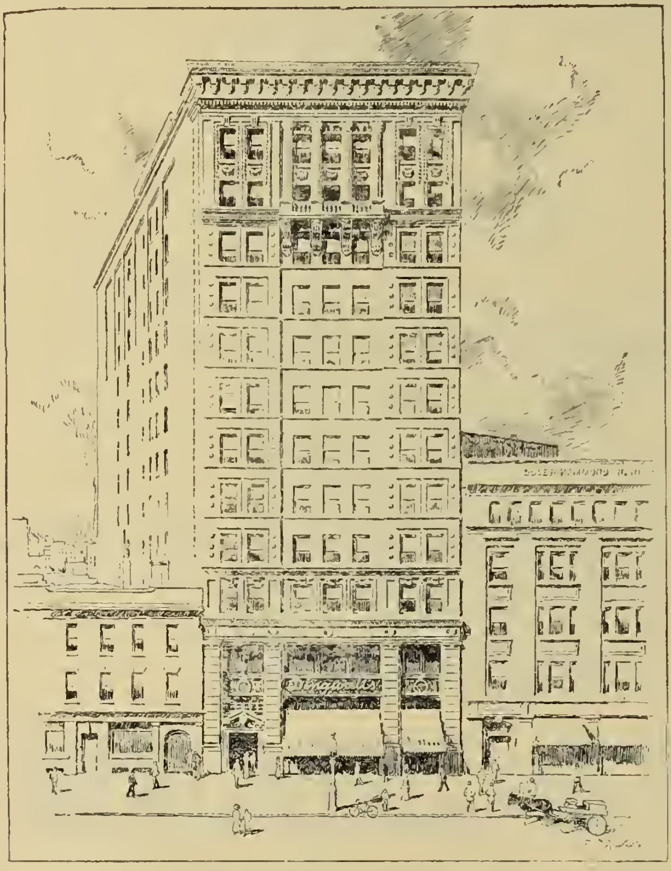
LIVE AGENTS WANTED ALL OVER CANADA

Across Canada with the

IMPERIAL WIRE & CABLE CO.

LIMITED

Toronto - MONTREAL - Winnipeg



Third of a series of advertisements showing buildings of national importance which have been wired with the Imperial Wire & Cable Co.'s, Limited, wires.

This picture shows the

McArthur Building, Winnipeg

This building was wired with "30% PARA" Rubber Insulated Wire

Architect - - - - - J. H. Russell, Winnipeg
Engineer - - - Charles L. Pillsbury, Minneapolis, Minn.
Electrical Contractors - Mitchell-Gray Electric Co., Winnipeg

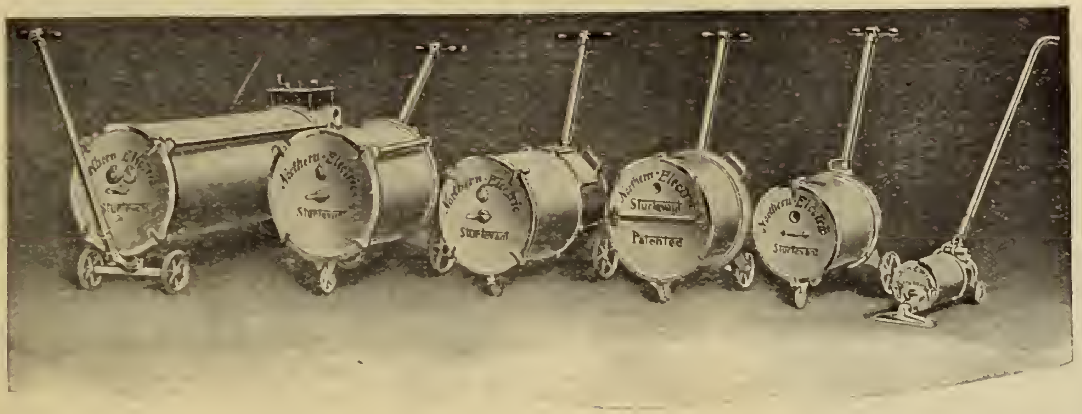
Northern Electric Company

LIMITED

Montreal Halifax Toronto Winnipeg Regina Calgary Edmonton Vancouver Victoria

Successors to IMPERIAL WIRE & CABLE CO., LTD.

Correspondence previously addressed to Imperial Wire and Cable Co. at 611 C.P.R. Building., Toronto, and 902 Electric R. Chambers, Winnipeg, should now be addressed to the Northern Electric Company, Limited, Simcoe St., Toronto, and 599 Henry Ave., Winnipeg.



Northern Electric
Sturtevant
Vacuum Cleaner

Agents—

do not miss sales because—

Northern Electric Sturtevant Vacuum Cleaners are made in sizes to suit all work and all purses. There are six sizes in the portable line and a complete range in the stationary type. The difference is in the size. All Sturtevant fans are equally reliable.

The Northern Electric Sturtevant line embraces every size of cleaner you will ever be asked for.

It will pay you to handle this line. You will not have to pass up sales.

Write for an Agency Proposition

Northern Electric Company
LIMITED

MONTREAL
HALIFAX
TORONTO

WINNIPEG
REGINA
CALGARY

EDMONTON
VANCOUVER
VICTORIA

Our Improved
Type "K" Meter.

Why Not Buy Canadian made Meters?

" Packard " Meters have been manufactured in Canada for the past fifteen years.

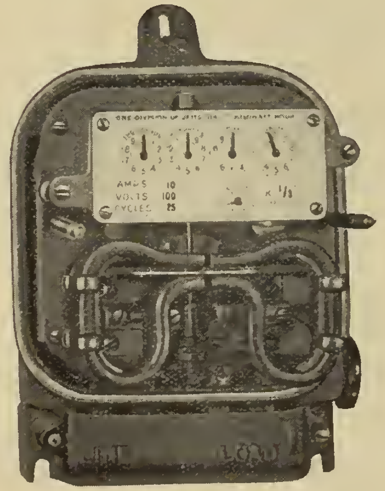
There are over 70,000 in use at the present time throughout Canada.

Government re-inspections have proven the " Packard " to be a meter that will ***stand up*** and retain its accuracy of calibration over years of service.

Our improvements are all up-to-date and there is no better meter made anywhere.

The " Packard " may cost a little more at the start, but it saves money in the end.

Packard



Showing Improved
Magnet Support.

LARGE STOCKS CARRIED AT

St. Catharines and Winnipeg;
St. John Railway Co., St. John, N.B.;
General Supplies, Limited, Calgary, Alta.;
Rudel-Belnap Machinery Co., Canadian Express Bldg , Montreal, Que.

The Packard Electric Co., Limited

Factory at St. Catharines, Ont.

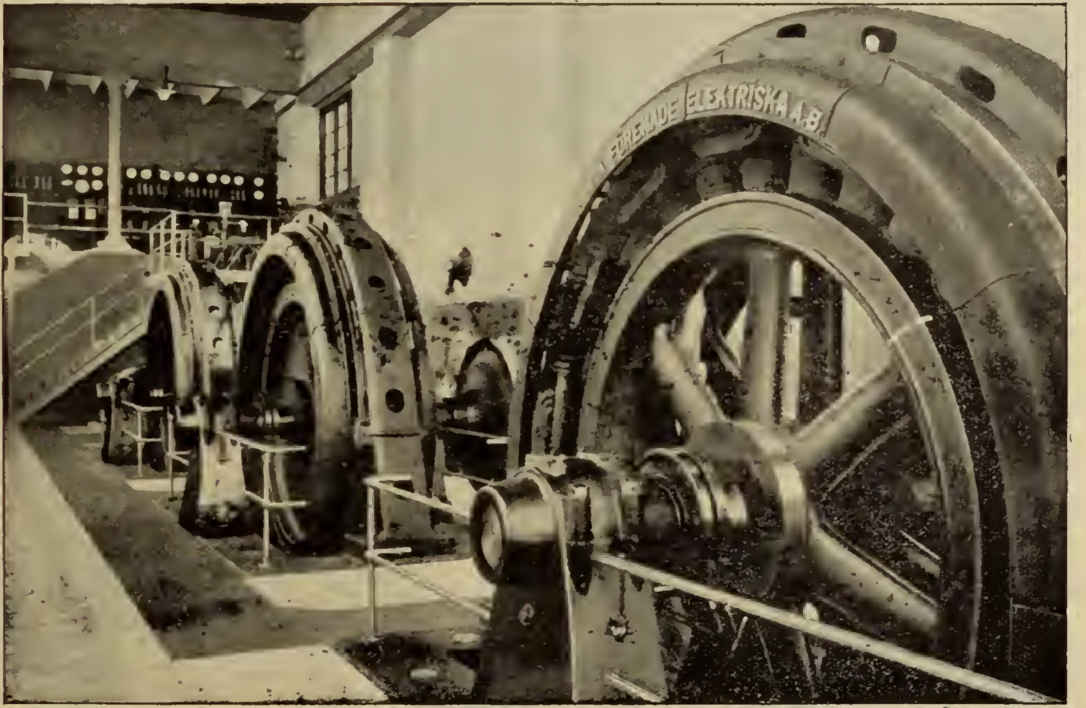
General Sales Office,
Traders Bank Bldg., TORONTO

N. W. Office and Warerooms,
WINNIPEG

Swedish Electrical Machinery

NOTED FOR

Efficiency and Workmanship



Hydro Electric Installation. Generators each 880 K.V.A. 225 r.p.m.
60 cycle. 6600 Volt.

We select your specifications for Electrical Equipment

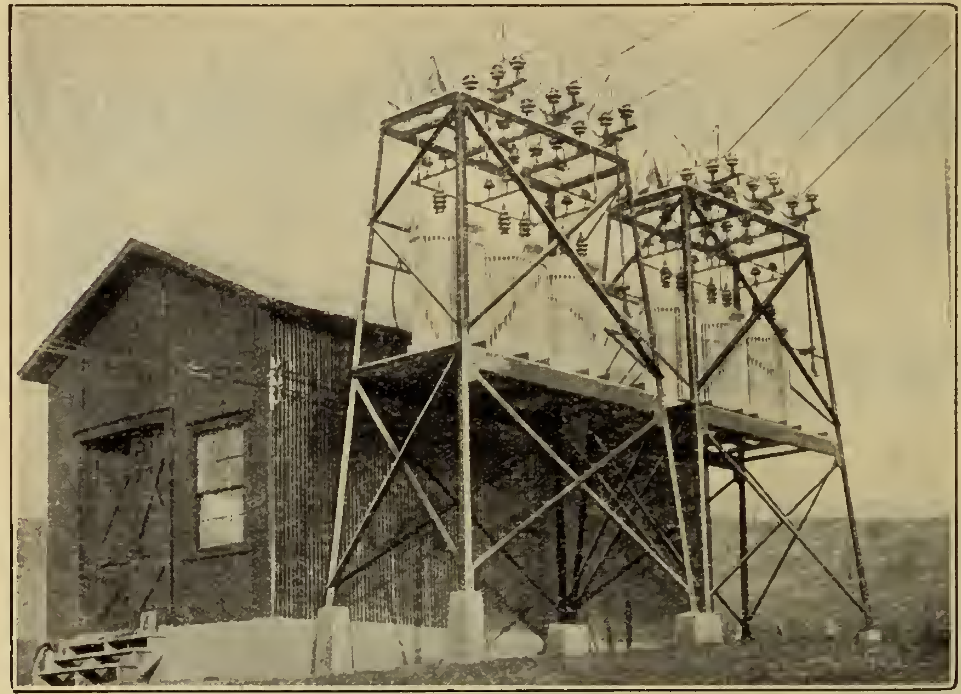
BURNHAM ENGINEERING COMPANY
LIMITED

Canadian Dealers for

The Amalgamated Electric Company of Sweden

Head Office:
Traders Bank Building,
TORONTO

Montreal Representatives:
Rudel Belnap Machinery Co., Ltd.
Canadian Express Bldg.



Simple
Inexpensive
Adaptable
Reliable
Convenient
Profitable

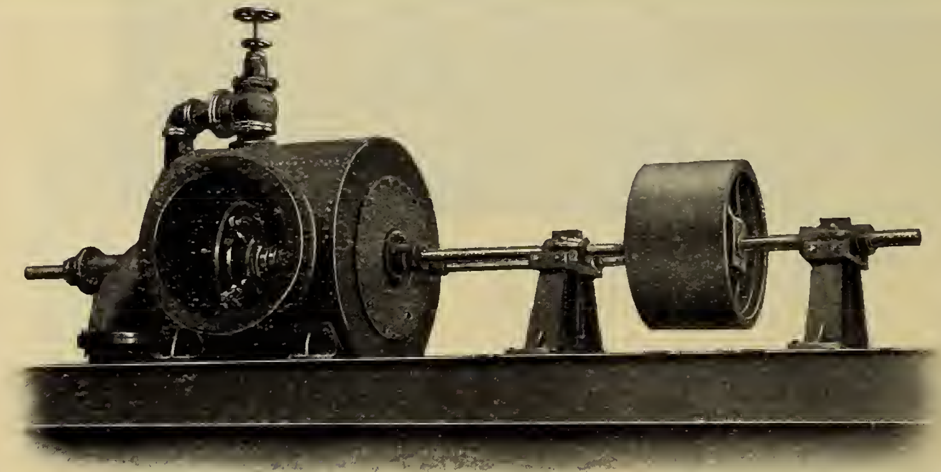
Installation in West Virginia.

One of the many Outdoor Sub-stations and application of Burke Horn Gap Apparatus.

RAILWAY & INDUSTRIAL ENGINEERING COMPANY

New York Representative
50 Church Street

PITTSBURGH, PA.



THE CANADIAN TURBINE WATER WHEEL
CONSERVE THE WATER POWERS
TRADE MARK.

REGISTERED

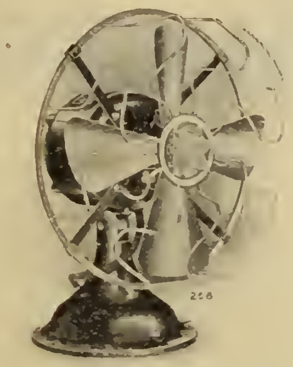
The Canadian Turbine Water Wheel

Stands to-day as the only safe investment for the man with a limited supply of water and varying conditions of head.

Single Horizontal, Steel Case with Relief Valve
Supplied to
Moirs, Limited, Halifax, N.S.

Horizontal Shaft and Vertical Shaft Turbine Units
of every Design

CHAS. BARBER & SONS, Meaford, Ontario
Established 1867



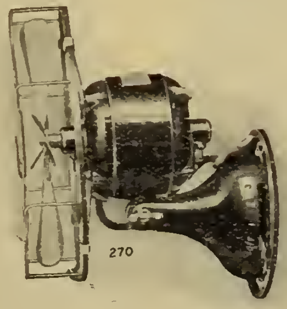
Our 8-In. Induction Type

The Success of the Season

We put it on the market in 1913. It jumped into immediate popularity. Small compact, handsome in appearance, self-starting induction type, motor and base in black enamel, blades and guard in brushed brass, lacquered. Moderately priced — a strong leader and a brisk seller.

Robbins & Myers "STANDARD" Fans

Write for Bulletin and our Dealers' proposition for 1914. Robbins & Myers "Standard" Fans have an 18 years' prestige back of them that makes them easy sellers. They are strongly advertised, renowned for economy of current, silent operation, freedom from fan-troubles, durability and steadiness. Follow the trend of the trade — get in with a live proposition!



The

Robbins & Myers Co.

Springfield, Ohio

We also make a complete line of A. C. and D. C. Motors for all purposes.

START RIGHT NOW!

USE

"LE CARBONE"

(Made in France)

Carbon Brushes

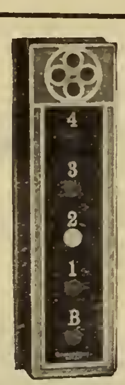
Their characteristic features are an absolute absence of cracks, flaws, hard spots and a perfect uniformity in their mechanical and electrical properties.

"Le Carbone" catologue contains many important facts about carbon brushes. You should have your copy.

Rougier Freres Inc.

63 Notre Dame, East
MONTREAL, P.Q.

CONNECTICUT



Type "L" made in all sizes and styles.

Electric Reset Annunciators

Thoroughly modern, up-to-date annunciators, which last indefinitely and give good service. Resets electrically — singly or in groups; the most sensitive drop — small current consumption; no permanent magnetos to demagnetize.

These are but a few of the many advantages of "Connecticut" Annunciators. Made in a wide variety of sizes and styles — each type specially suited to its particular purpose.

Interior Telephones

include systems for Public Buildings, Private Residences, Hotels, Apartment Houses, etc. Special systems designed when desired.

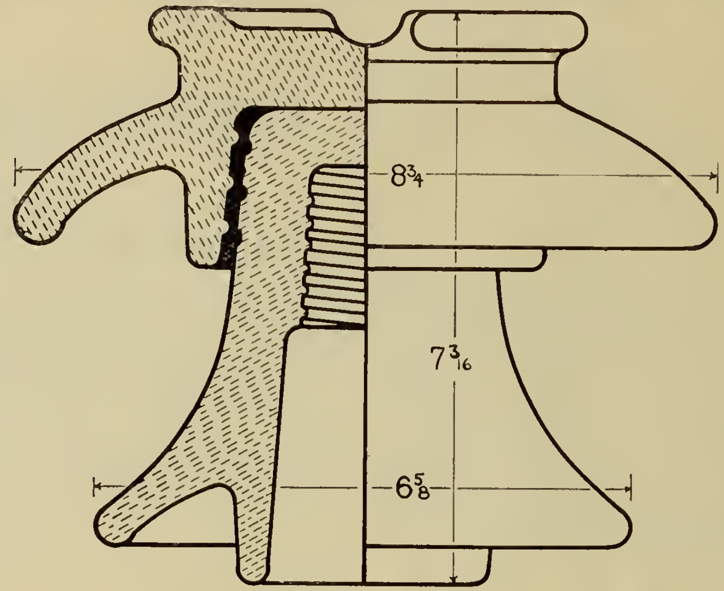
For 20 years we have specialized on these lines. Our instruments have built a lasting reputation for high quality and reasonable prices.

Canadian Representatives Wanted. Write for Catalog 22C and full particulars.

Connecticut Telephone and Electric Company, Inc.

Meriden, Conn., U. S. A.

CANADIAN INSULATORS



Number	133
Line voltage	30,000
Test voltage	100,000
Rain test	65,000
Leakage distance	17¾-in.
Pin hole	1⅜-in.
Net weight	10½-lbs.
Packed weight	12-lbs.
No. per crate	6

The Canadian Porcelain Company, Limited

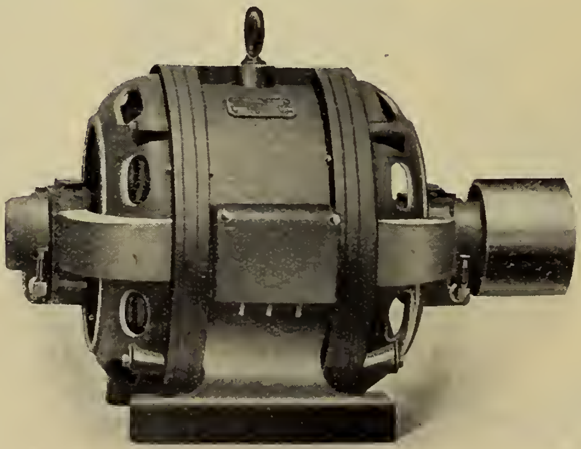
HAMILTON, - CANADA

"UNION" Dynamos and Motors

For All Industrial Purposes

Estimates given for all special designs of motor and engine driven generator sets.

Write for our motor stock list published monthly and take advantage of our prompt deliveries.



Pattern H D Squirrel Cage Motor

Canadian Union Electric Co., Limited
Head Office: 130 Wellington St., West, Toronto
Also at 9 St. Nicholas St., Montreal

Represented in Winnipeg by:
The Mainer Electric Co., Limited
61-63 Albert St.

ON THE TOWER LINE

Engineering counts.

Substantial line construction with high-tenacity hard-drawn stranded

ALUMINIUM

conductors spells good engineering.

Let us put up to you six points in which Aluminium is superior to Copper.

THE BRITISH ALUMINIUM COMPANY, LIMITED
(of London, England)
60 WEST FRONT STREET, TORONTO
Phone Ade. 3368
Cables, Cryolite

EUREKA

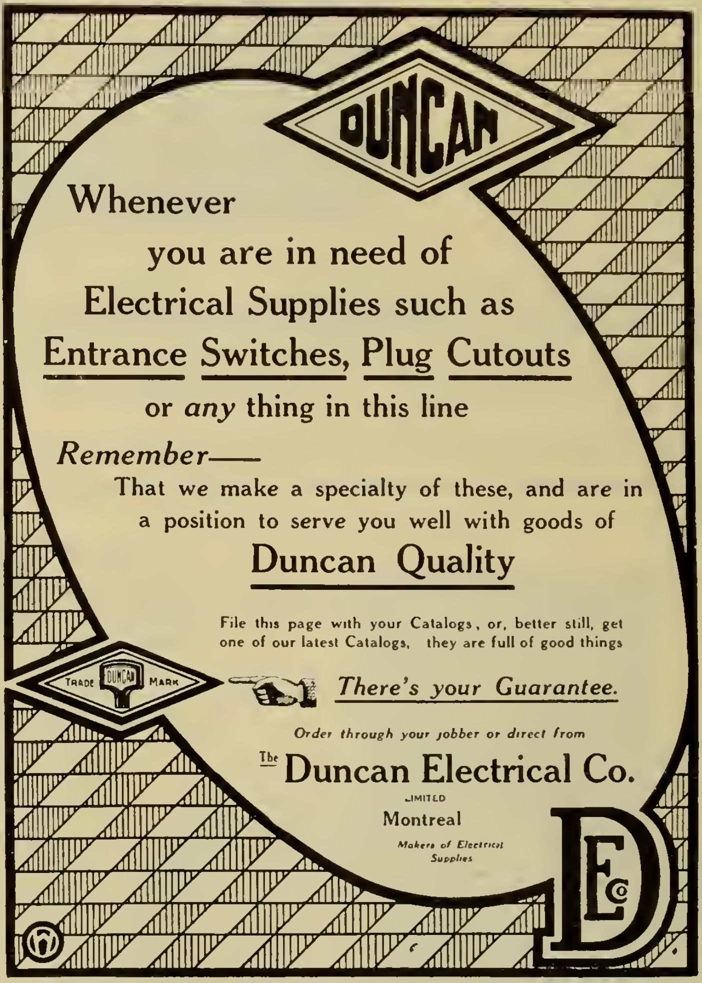
A Light Powerful Electric Vacuum Cleaner

1914 Model

This complete cleaner is something that many of your customers will buy upon demonstration. The Eureka is light and easily operated, it has tools for cleaning everything in a house and the cost is very reasonable. The motor is made specially for the purpose in our own factory and will last a lifetime. The Eureka is a high grade machine, absolutely guaranteed. If you do not know the Eureka send for circular and dealers proposition.

ONWARD MFG. CO.
BERLIN, ONT.

A Good Tip



DUNCAN

Whenever
you are in need of
Electrical Supplies such as
Entrance Switches, Plug Cutouts
or *any* thing in this line

Remember——
That we make a specialty of these, and are in a position to serve you well with goods of
Duncan Quality

File this page with your Catalogs, or, better still, get one of our latest Catalogs, they are full of good things

TRADE DUNCAN MARK

There's your Guarantee.

Order through your jobber or direct from

The Duncan Electrical Co.
Limited
Montreal
Makers of Electrical Supplies

DE Co

Have you pasted this in your note book yet? Do it now.

Use this sales plan

We finance it — you back it up with personal calls

This is a campaign for window lighting and wiring business, using X-Ray Reflectors. We launched it last month. 250 Contractors, central stations etc., have taken it up so far. Sales have been most gratifying.

This is the plan -- it costs you nothing

You carefully compile a list of names and addresses of the merchants in your locality who need better window lighting. Mail it to us. At our expense, we mail each merchant the three folders at intervals of two days. Each folder has a return card. **This card bears your name** and when the merchant mails it you get the inquiry **direct.**

You wait till the three folders have reached the merchant and then call personally on each. Try and get permission to make a demonstration of X-Ray window lighting in his windows, in a dark room, or in the cellar if need be. Once the merchant sees the "search light" effect he grasps the idea and the sale is easily made.

To assist you, we offer to ship you four Scoop Reflectors and bill them to you **four months from date** with permission to return them if the plan fails.

As you're reading this, make out a list of 25 or 50 names. Give this plan a trial.

Now read about the Results it gets

This is an extract from a letter received from a South Carolina contractor:

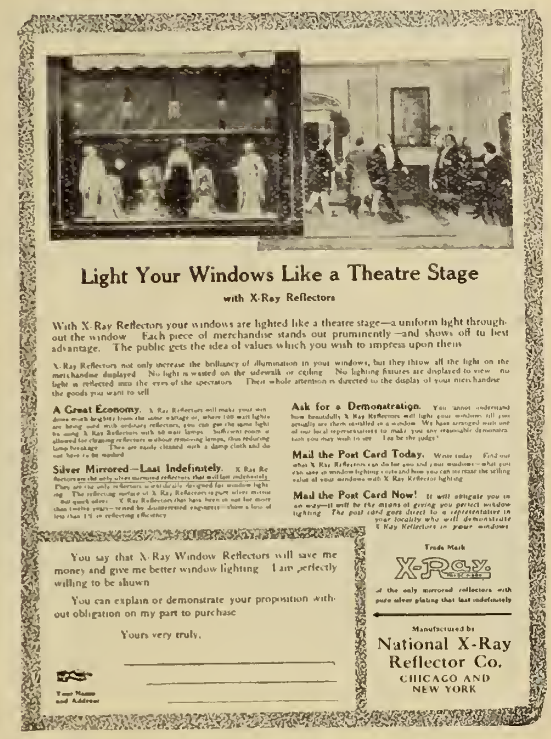
> "We have received the sample reflectors and have made several demonstrations. In nearly every case where we demonstrated these reflectors we got an order, and in the cases where we did not get an order we still have good prospects."

Here's one from LaCrosse:—

> "The circulars you sent out have had effect already," writes a LaCrosse, Wis., contractor, "as the Helfach Jewelry Store called us up this morning and we are going to install the reflectors in their window this afternoon."

What is being done in South Carolina and Wisconsin can ALSO be done in California, Maine and Tennessee,—by YOU.

You can't get business any easier. Send the list in right now, before you forget it.



Light Your Windows Like a Theatre Stage

with X-Ray Reflectors

With X-Ray Reflectors your windows are lighted like a theatre stage—a uniform light throughout the window. Each piece of merchandise stands out prominently—and shows off to best advantage. The public gets the idea of values which you wish to impress upon them.

X-Ray Reflectors not only increase the brilliancy of illumination in your windows, but they throw all the light on the merchandise displayed. No light is wasted on the sidewalk or ceiling. No lighting fixtures are displayed to view: no light is reflected into the eyes of the spectators. Their whole attention is directed to the display of your merchandise—the goods you want to sell.

A Great Economy.

Silver Mirrored—Last Indefinitely. X-Ray Reflectors are the only silver mirrored reflectors that will last indefinitely.

Ask for a Demonstration.

Mail the Post Card Today. Write today. Find out what X-Ray Reflectors can do for you and your windows—what you can save in window lighting costs and how you can increase the selling value of your windows with X-Ray Reflector lighting.

Mail the Post Card Now! *It will obligate you in no way—it will be the means of giving you perfect window lighting. The post card goes direct to a representative in your locality who will demonstrate X-Ray Reflectors in your windows.*

You say that X-Ray Window Reflectors will save me money and give me better window lighting. I am perfectly willing to be shown.

You can explain or demonstrate your proposition without obligation on my part to purchase.

Yours very truly,

Your Name and Address

Trade Mark

X-Ray

the only mirrored reflectors with pure silver plating that last indefinitely

Manufactured by

National X-Ray Reflector Co.

CHICAGO AND NEW YORK

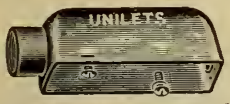
National X-Ray Reflector Co.

CHICAGO
225 W. Jackson Blvd.

NEW YORK
6 East 39th St.

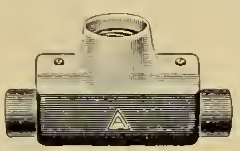
"UNILETS"

are drawn from steel and possess many merits which are an absolute necessity for up-to-date conduit work. For durability, neatness, space for making wire connections, "Unilets" meet all requirements. "UNILETS" are mechanically right. The conduit is steel, why not the fitting? Try them on your next job. Copy of booklet "UNILETS" mailed on request.

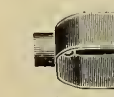


Cat. No. 9001—Rectangular Unilet.

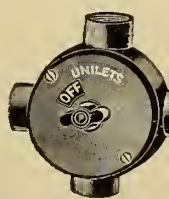
Cat. No. 9202—Rectangular Unilet.



Type No. 2—Rectangular Unilet. Cat. No. 9002 with No. 7650 Receptacle.



Type No. 1 Octagon Unilet. Cat. No. 7501.

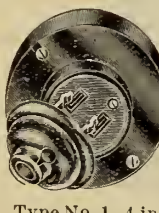


Type No. 4— Round Unilet with enclosed Snap Switch.

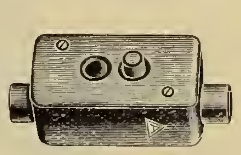
Cat. No. 7322—Shade Holder

Cat. No. 6906 Vapor-Proof Unilet.

Combination Plug Receptacle and Push Button Switch Unilet—Hubbell Plug Receptacle and Arrow E Push Button Switch Attached.



Type No. 1—4-inch Round Unilet with Two-phase Receptacle Attached.



Type No. 2 – Switch Unilet. Cat. No. 6501, with Push Button Switch Attached.

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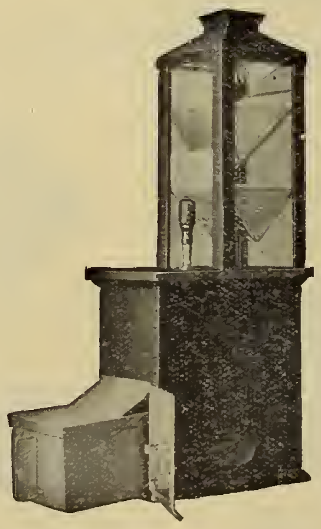

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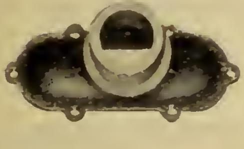


Straight-Away

Illustration shows a three-pole "Noark" Service Box for use with or without conduit wiring. For conduit work the fittings with gaskets make this box water-tight.

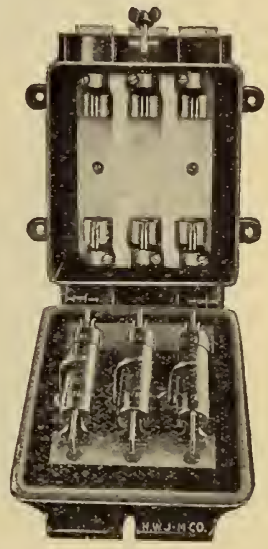
"NOARK" SERVICE BOXES

have a handle on the cover which operates the fuse carrier hooks in the box. With the hooks engaging the fuses, the cover can be opened or closed, giving the same action as a knife switch. By closing the cover and giving the operating handle a quarter turn, the fuses are disengaged and left in circuit when the cover is opened.

"Noark" Service Boxes are approved by the Underwriters' Laboratories for use as a switch and a cut-out.

The "Noark" line of boxes covers a wide range and variety of uses, applicable to all forms of installations.

Write our nearest Branch for Catalog No. 406



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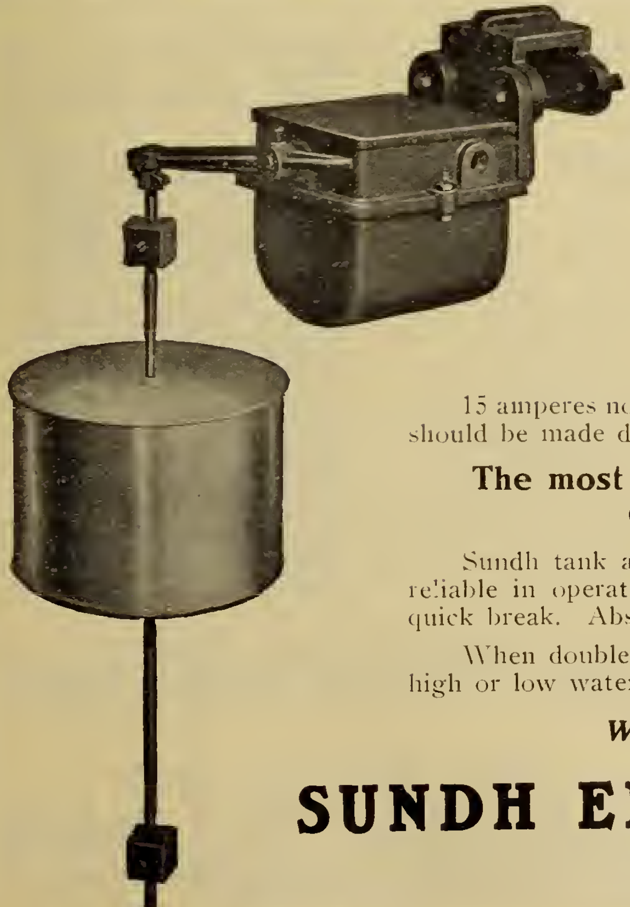

Sundh Tank and Sump Switches.

Rating

30 amperes normal capacity at 115 and 230 Volts A. C. or D. C.

15 amperes normal capacity at 440 Volts A. C.

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The most serviceable switches produced for Controlling Water Levels

Sundh tank and sump switches are rugged in construction and reliable in operation. Have a snap action which unfailingly gives quick break. Absolutely weatherproof.

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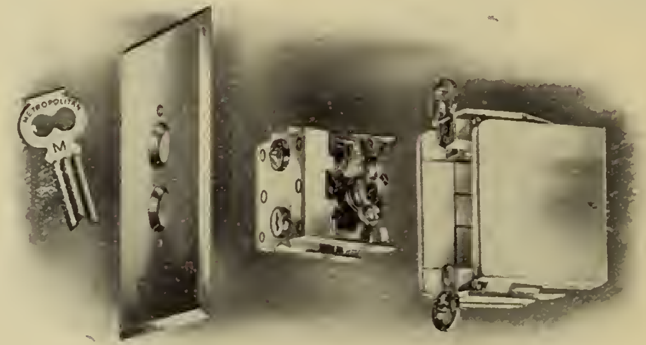

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push lock switch.

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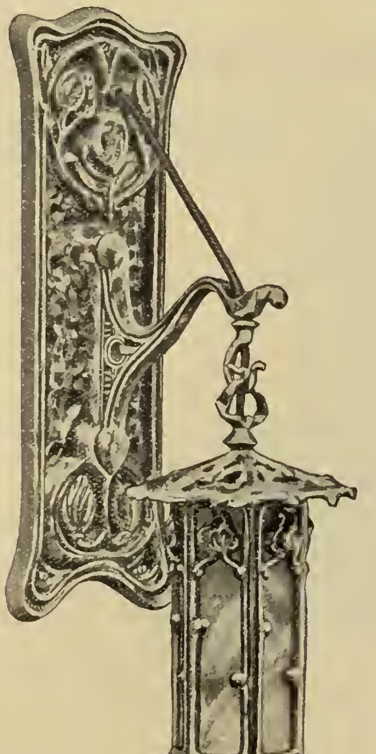

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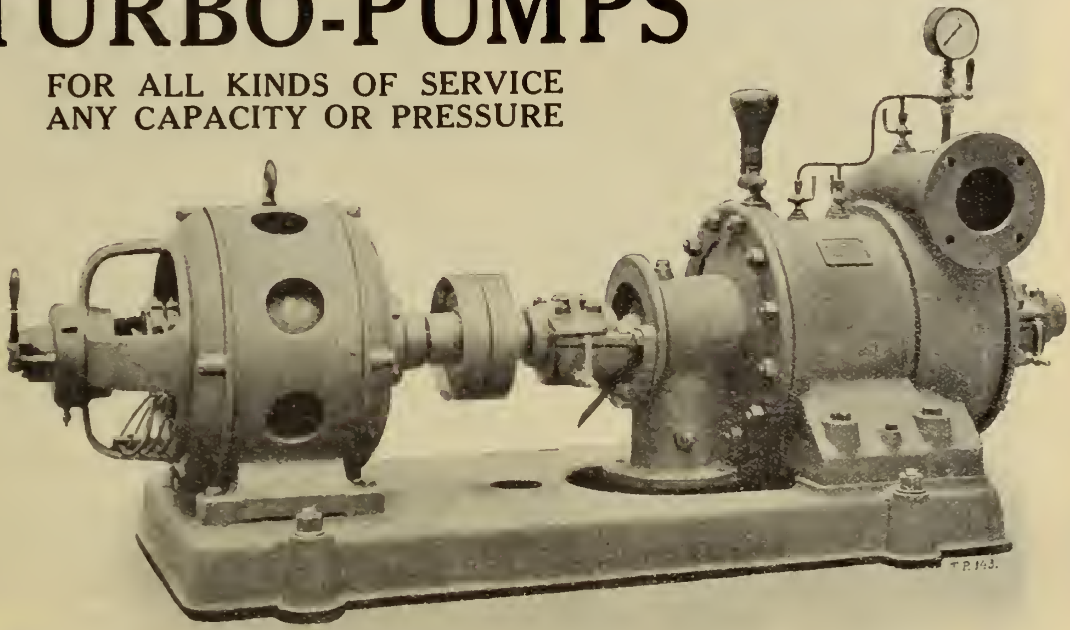

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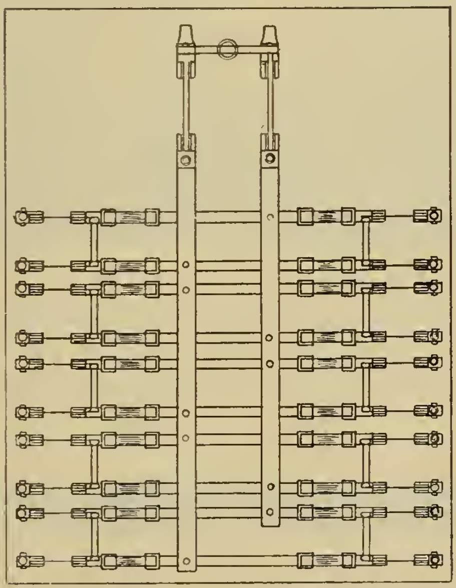

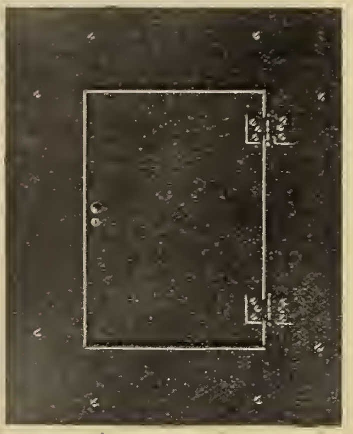

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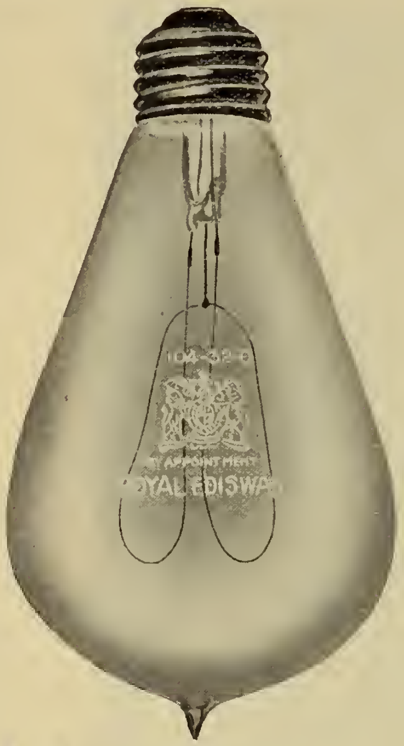

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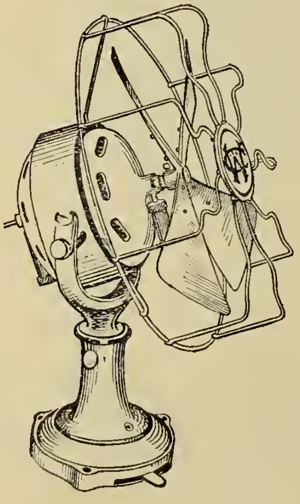

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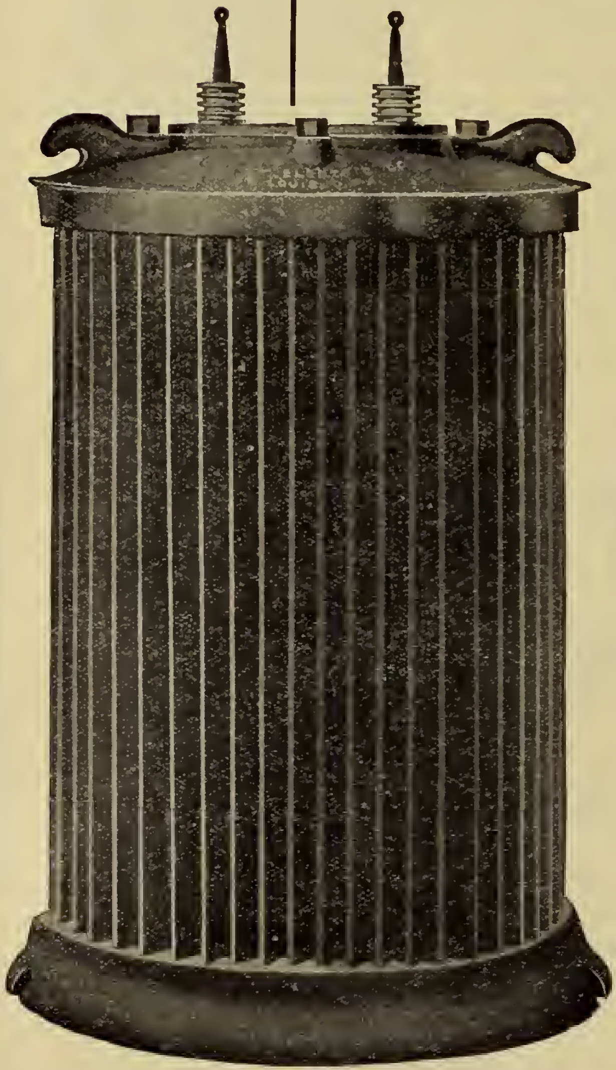
CANADA WIRE & CABLE CO. LIMITED
CANADA
TORONTO CANADA

Moloney Oil-Cooled Transformers



This type of Moloney Transformer is built for heavy duty and will give efficient services on high voltage lines.

Oil ducts are provided for coils and core giving to all parts free contact with the circulating oil.

Corrugated sheet metal sides are cast solidly into cast-iron bottom. All strain is carried by the inside bolts which secure the cover to the bottom casting.

All lead wires are brought out through heavy porcelain bushings in the top of the cast-iron cover.

This transformer is fully described in our illustrated catalogue.

To Central Station Men

A special line in the manufacture of Moloney Transformers is our PIPE THAWING TRANSFORMER. One of these in your Central Station means a paying proposition to you. This is the season for their use. Write us at once for full particulars and prices on Moloney Pipe Thawing Transformers. They last a lifetime.

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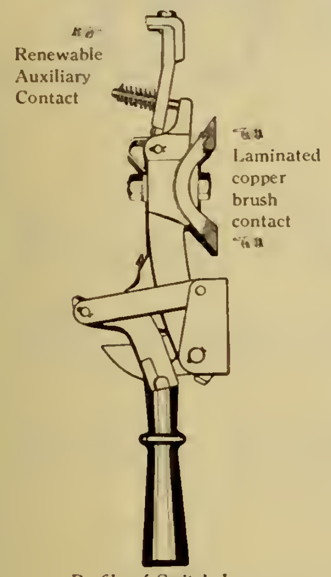
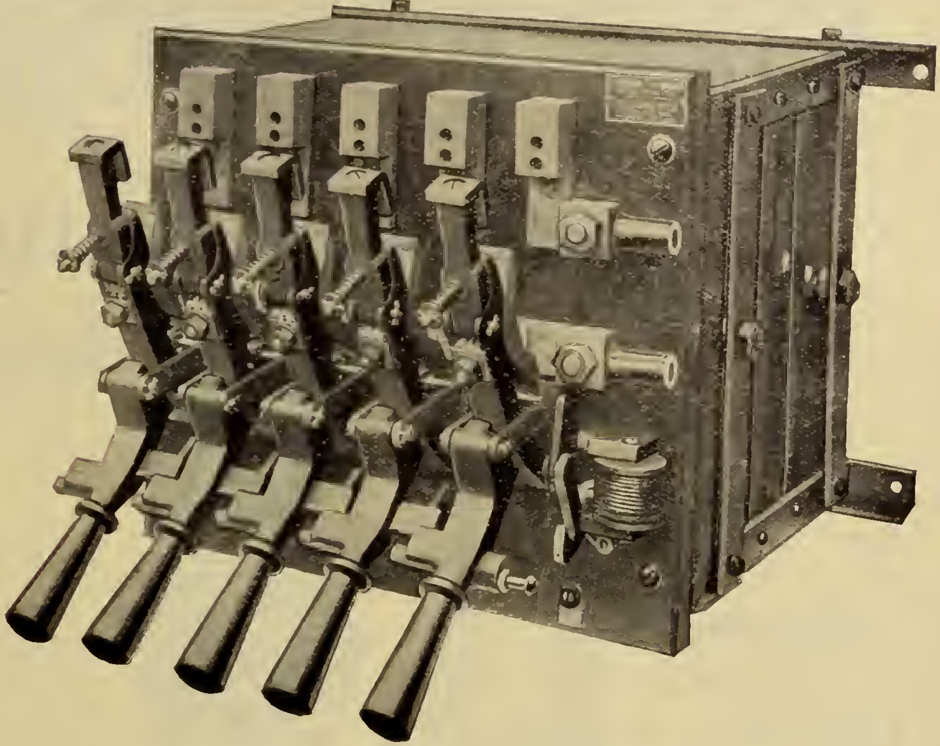


Profile of Switch Lever



Cutler-Hammer Multiple Switch Type Motor Starters

are of exceptionally rugged construction and have sufficient resistance to cope with the heavy over-loads encountered when starting large motors or motors of medium size under severe conditions. When more than 5 seconds are required for acceleration the multiple switch starter is preferable.

The cutting out of each step of resistance is accomplished by a separate lever, the levers being so interlocked that it is impossible to close them except in the proper order. The auxiliary renewable contacts take the wear which is slight because of the snappy action of the switches in closing and opening.

For Severe Starting Service

The Cutler-Hammer Multiple Switch Type Starter insures proper starting of large motors and motors of medium size that are started under severe conditions.

With this type of starter the closing of the individual switches ntroduces a desirable time element, preventing the acceleration of the motor too hastily. The individual switches of

CUTLER-HAMMER
Multiple Switch Starters

can only be closed in their proper order, insuring proper cutting out of the resistance and proper acceleration. It is also impossible to burn out the resistance due to leaving part of the switches closed.

Five times as much current can be carried by the laminated brushes and hard rolled copper contacts of multiple switch starters than by sliding contacts.

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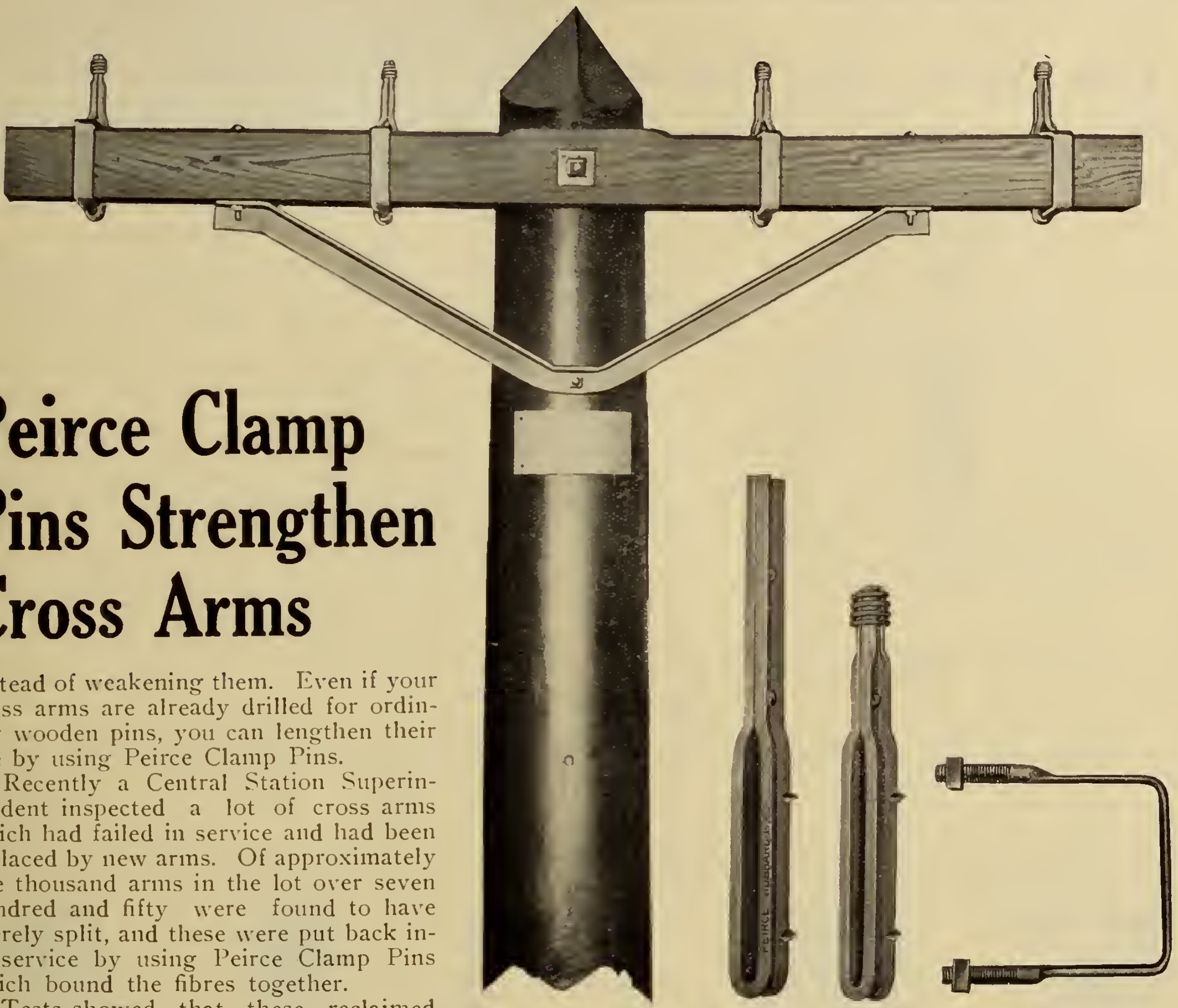

Peirce Clamp Pins Strengthen Cross Arms

instead of weakening them. Even if your cross arms are already drilled for ordinary wooden pins, you can lengthen their life by using Peirce Clamp Pins.

Recently a Central Station Superintendent inspected a lot of cross arms which had failed in service and had been replaced by new arms. Of approximately one thousand arms in the lot over seven hundred and fifty were found to have merely split, and these were put back into service by using Peirce Clamp Pins which bound the fibres together.

Tests showed that these reclaimed arms when so equipped were stronger than new arms with wood pins.

The pins are rolled out of open hearth steel, properly designed for the exacting demands of modern service. The heavy coat of hot galvanizing gives full protection against rust.

Isn't it perfectly evident that, whereas a cross arm is seriously weakened by drilling holes for ordinary pins, it is bound to be stronger when clamped with steel bands such as those used in installing Peirce Clamp Pins?

Remember that a locust pin loses 40 per cent of its strength the first year, while the Peirce Clamp Pin lasts forever, and will carry an 800 lb. strain without deflection. All Peirce Clamp Pins are equipped with

The Peirce Spring Thread

which allows for expansion, contraction or inequality of bore, yet holds the insulator securely at all times.

In hot weather, it elongates and creeps further up in the insulator thread, preventing destructive pressure on the glass—in cold weather it still keeps closely in contact, and the insulator can't wobble.

Its resiliency is another advantage, helping to absorb sudden jerks or strains to which the wires might be subjected.

Peirce Specialties and Hubbard Line Hardware are carried by Canadian Electrical Jobbers.

The Hardware MAKES the Line, Hubbard Makes THE Hardware

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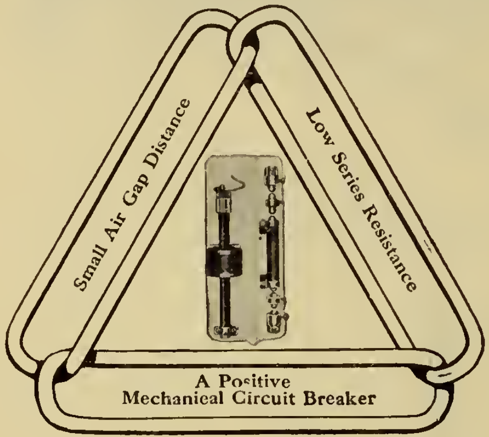
You Get The Three Vital Functions and a "Guarantee" When You Buy Garton-Daniels.



These vital functions in your lightning arresters are small air-gap distance, low series resistance and a positive mechanical circuit breaker.

A small air gap distance that will break down and discharge lightning or excessive voltages before they reach values high enough to puncture the windings of your apparatus. Small air gap distance means efficient protection.

A low series resistance that will prevent surges, low voltages, winking lights, and other disturbances at the time the arrester discharges. This means satisfactory service to your customers.

A mechanical circuit breaker—the only positive means for cutting off the flow of line current following the lightning discharge to ground. This means the elimination of lightning arrester grounds and short-circuits—and continuous service during the heaviest lightning storms.

Garton-Daniels Lightning Arresters are the only lightning arresters combining every necessary function of a complete lightning arrester. Furthermore every A. C. type is unconditionally guaranteed for one year.

Get these three vital functions and a "guarantee" when you order lightning arresters. You can get them only in the Garton-Daniels—the **"complete"** arrester.

Write for quotations.

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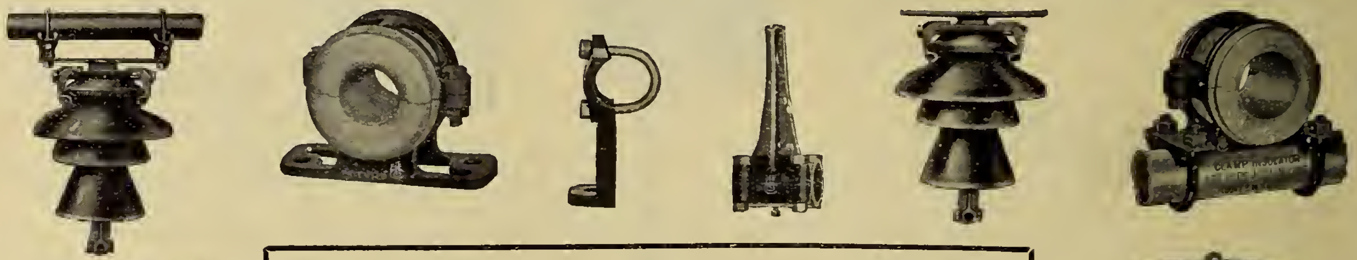

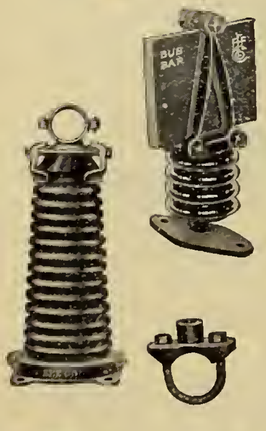

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Generation, Transmission and Application of Electricity

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Subscribers are requested to promptly notify the publishers of failure or delay in delivery of paper.

Vol. 23 Toronto, April 1, 1914 No. 7

Canada's Water Powers

On other pages of this issue we print a review of the latest report of the Water Powers Branch of the Canadian Government which deals chiefly with the water falls of western Canada. Two ideas stand out prominently in this report, namely, the steady increase in the total capacity of Canadian water powers in proportion as surveys are carried out by our engineers; and second, the tremendous possibilities of increasing the already large total by proper storage facilities.

This latter looms up as one of our biggest problems of the present century. Apparently it is far too huge an undertaking for private capital. In addition to this the regulation of the flow of any river or any group of rivers in a certain section will have such far-reaching influence that it would seem unfair to expect any private corporation interested in one or two developments only to undertake the regulation of a water flow which may effect favorably a number of other companies. It would appear therefore that it is a government problem and one which must be seriously considered in the not distant future—a systematic survey of the water storage possibilities of the whole Dominion looking to the generation of the greatest possible amount of electric energy and the prosecution of the work of building the necessary dams as our population increases and the demand renders further power necessary. In the interests of economical development it is urgent that as much be known as possible about our various water powers, and much as the government is doing at the present time we are of the opinion that still greater efforts are necessary and that a still larger staff should be employed so that a more minute knowledge of the possibilities of our water powers, great and small, under the most ideal development conditions should be calculated with as great a degree of accuracy as is possible under present conditions of modern engineering practice.

Aluminium Cables

The use of aluminium cable is comparatively a recent introduction in America though it has been practised for some years to some small extent on the European continent.

The objection that is most often heard is that the necessarily larger size of aluminium core, to give it the same carrying capacity, will make the cable uncomfortably large and bundlesome to handle, necessitating larger conduits, etc. The question of cost, however, is the all important one, other things being equal, and it has latterly been shown that, under existing price conditions for copper and aluminium cable, aluminium core can be manufactured for certain voltages and carrying capacities so as to compete with copper cables.

This matter is dealt with in a paper on aluminium insulated cables on other pages of this issue by Mr. E. V. Pannell. Mr. Pannell is thoroughly conversant with the conditions surrounding the relative advantages of aluminium and copper and his paper contains much valuable information on a subject which has been a matter of more than average interest among electrical engineers during the past year or two.

Electrical Section C. S. C. E.

At the meeting of the Electrical section of the Canadian Society of Civil Engineers, held in Montreal on March 20th, four papers on insulators in relation to high tension work were read. Mr. R. M. Wilson presided. The discussion was introduced by Mr. Julian C. Smith, of the Shawinigan Water and Power Company, who referred to the work of hydro-electric engineers in investigating the failures of insulators on transmission lines. There were considerable difficulties in making tests and deteriorations occurred both in the pin head and suspension types. Mr. Smith enumerated causes which led to failures and suggested that the experience of engineers along this line would be valuable. A paper by Mr. J. B. Walls, chief engineer of the Pennsylvania Water and Power Company, gave exhaustive data as to experiments made to ascertain damages caused by lightning. Mr. J. Morse, the chief operating engineer of the Shawinigan Company, spoke of the tests made by that company, which are still being carried out; and Mr. Austin, of the Ohio Brass Company, showed a number of stereoptican views illustrating the various types of insulators and the damage caused by surges. Mr. Austin detailed the causes which led to the failure of insulators under excessive strains, and referred to the means taken to prevent the breakdown of the insulators. There was, he said, a considerable field for further investigations, as they were still in the dark as to all causes of the failure. The manufacture of insulators had been greatly improved, particularly in the matter of glazes, but it sometimes happened that insulators after passing tests, failed from causes practically impossible to detect at that time. Mr. K. B. Thornton, Mr. J. M. Robertson, Mr. J. C. Smith, the chairman, and others took part in a short discussion. The chairman suggested that the operating engineers should get together with the manufacturers, tell them their requirements, and that the makers should find out methods to fill their requirements.

Auxiliary Plant Insurance

The Quebec Telegraph, which was the first newspaper in Canada to instal an individual electric motor plant, has recently installed an auxiliary gas and electric plant, to be protected against any accident to the local electric power.

The new plant consists of a 50 h.p. Crossley gas engine, and Edison generator, which can be set in motion inside of a few minutes. At the present time the mechanical plant of the Telegraph is run by a 50 h.p. Crocker-Wheeler motor-generator set, which receives alternating current from the local company, and transforms it into direct current, which is delivered to over 25 individual motors, throughout the establishment. This electrical installation has been running almost incessantly day and night, for the past five years without a stop, but the management of the Telegraph considered that it was time to give this machinery an over-hauling, and this added to the possibility of an accidental tie up in the service, through accident, at any time, led the Telegraph Printing Company to instal the auxiliary plant. Every machine in the newspaper, job printing, and book-binding departments of the five-storey building of the Quebec Daily Telegraph has an individual electric motor.

Canadian General Electric Annual

The annual report of the Canadian General Electric Company for the year ending December 31st, 1913, has just been made public. Gross profits are $2,029,898, a slight increase over 1912. The net profit is placed at $1,336,339, some $60,000 less than the previous year, the result of a larger allowance for depreciation coupled with bigger interest charges. These net earnings represent about 67 per cent. on the $2,000,000 preferred stock of the company, and, after the preferred dividend has been paid, leaves about 15 per cent. on the $8,000,000 common stock. The report is an unusually good one, especially considering the trade conditions of last year.

George Westinghouse

George Westinghouse, founder of the Westinghouse Electric & Manufacturing Company and allied companies died on Thursday, March 12, of heart disease. Mr. Westinghouse was born at Central Bridge, N.Y., in 1846 and his name for the last forty years has been inseparably connected with a number of the most progressive ideas and far-reaching inventions in the electric world. Among the most important of his inventions is the air brake which has been applied, with modern improvements to railway work of all kinds, both steam and electric. Mr. Westinghouse was also closely associated with the inventions which have led up to the modern railway signal and switching installations.

The Westinghouse Electric Company was formed in 1886 for the manufacture of lamps and electric lighting apparatus. In 1889 the United States Electric Company was absorbed and in 1890 the Consolidated Electric Light Company was added. In 1891 the Westinghouse Electric & Manufacturing Company, which is now known the world over, and employs in its workshops and sales departments over 20,000, was formed.

As indicating the activities of Mr. George Westinghouse it may be noted that he was associated with a large number of electrical companies. He was president and director of Westinghouse Air Brake Company; Westinghouse Machine Company; Nernst Lamp Company; The Union Switch & Signal Company; Societe Anonyme Westinghouse, Paris; Cooper Hewitt Electric Company; Pittsburgh Meter Company; Societe Italiene Westinghouse, Italy; The East Pittsburgh Improvement Company; The Westinghouse Brake Company, Limited, London; Westinghouse Cooper Hewitt Company, London; Westinghouse Friction Draft Gear Company; Westinghouse Metal Filament Lamp Company, Limited, London. He was also chairman of the Board of Directors of Westinghouse Electric Company, Limited, London, and director Westinghouse Electric & Manufacturing Company; The Traction & Power Securities Company, and Westinghouse Metallfaden Gluhlampenfabrik, Vienna.

The Cost of a Small Electric Plant

By Mr. Robert L. Riggs

The town of Strassburg, Saskatchewan, is one of the typical, small Western towns where the lighting problem has been under discussion and solved satisfactorily. About a year ago the ratepayers decided to abolish the old-time acetylene lamps and kerosene oil-lamps, and to have an up-to-date electric lighting station. A by-law was passed by a large majority and the councillors, having called for tenders, decided to purchase a gas producer power plant.

The power house is located conveniently near the railroad track, and is built of brick with a stone foundation, the roof being covered with Carey's prepared roofing material. The gas producing equipment consists of a Ruston Proctor generator and an engine 45 B.h.p. with the usual auxiliary vaporizing and scrubbing apparatus. A self-driven air compressor and receiving tank is provided for starting the engine. The engine is of the horizontal single cylinder, centre crank type, with double ignition system and special type governor for electric lighting duty. The engine is equipped with a flywheel, 8 ft. x 14 in. face, weighing 8,500 pounds.

The cooling water required is 2½ gallons per horse power hour, and four galvanized iron tanks provide circulating water for this purpose.

First Cost of 30 kw. Gas Producer Station*

Real estate, 3 lots at $50 each	$ 150.00
Building	1,812.30
Excavation and building foundations	446.45
Digging well	191.50
Bonds	30.00
Producer, gas engine, tanks, belts and foundations	5,750.00
Generator, 30 kw.; exciter; switchboard; tungsten street lighting equipment; pole line and transformers	4,250.00
Meters, 50	509.00
	$13,139.25

The electrical unit is connected to the engine by a balata belt 45 ft. by 9 in. and consists of a Canadian General Electric alternating current generator, 37½ kv.a., three-phase, 60 cycle, 1200 r.p.m., 2200 volts, and a 2½ kw. belted exciter, 125 volts, d.c.

A two-panel white Italian marble switchboard is installed with the necessary voltmeter, ammeters and instrument transformers. Also the main line oil switch is mounted at the rear. One panel takes care of the distribution system and the other controls the street lighting.

There are twenty-five series tungsten, 100 watt, street lights and the town proposes installing fifteen additional lights. The distribution system is two miles long. No. 8 weather-proof triple braid wire is strung on cedar poles 30 ft. by 6 in. top. These are placed in the lanes, except the poles for the street brackets, which are on the curb line. There are sixty-five connections, the service leads all being connected at the rear of the buildings.

The following pole type, single phase transformers step the voltage down from 2200 to 110 volts for commercial purposes,—one 10 kw. 2200-220/110 volts; two 5 kw. 2200-220/110 volts; three 3 kw. 2200-220/110 volts.

As the citizens desire an all-night service, a rate of 18 cents per kilowatt hour is charged with a minimum of $1.00 a month to cover meter rent. The town is paying $20 a year per light for the street lights and is quite satisfied with the service.

Fixed charges on plant.—

Interest, at 7½ per cent. on first cost	$985.44
Depreciation and obsolescence, 5 per cent...	656.96

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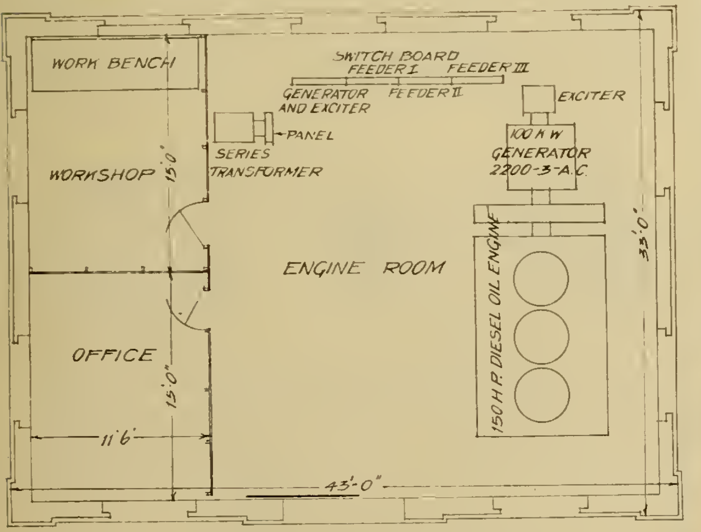
* Engineering fees and expenses excepted.

Insurance	100.00
Repairs and renewals, 4 per cent.	525.57
	$2,267.97
Operating Expense per Year—	
Plant running 12½ hours per day, yearly average,—	
Coal anthracite, 90 tons at $8.40	$ 756.00
Operator	1,200.00
Assistant	480.00
Bookkeeper	300.00
Office, miscellaneous expenses	240.00
Oil, waste, etc.	180.00
	$3,156.00
Plus fixed charges on plant	$2,267.97
	$5,423.97

In the producer, Pennsylvania anthracite coal is burned, costing $8.40 per ton delivered in the power house. The analysis of the coal shows 13,289 thermal units per pound. The plant is giving a 16½ hour service, and the revenue per month is steadily increasing. The population served is about 1200.

Diesel Plant in Salmon Arm

Soon after incorporation the council of the city of Salmon Arm took up the question of installing an electric light plant and sewerage and waterworks systems, and commissioned DuCane, Dutcher & Company, consulting engineers, of Vancouver and Calgary, to report on all three schemes. In June, 1912, the engineers reported favorably on a Diesel engine-driven electric plant, and a gravity water system, and also a sewerage system. The report was accepted and steps were at once taken for the installation of all except the sewerage. The power plant consists of a 110 kv.a. Diesel engine plant with direct-connected exciter, a 4-panel switchboard, and a 12 kw. constant current transformer and panel to control the series street lights. The engine is 150 B.h.p., 27.7 r.p.m., three cylinder, vertical type, and was supplied and installed by the Swedish Diesel Company, of Stockholm, who are represented in Vancouver by the E. P. Kay Company, Limited. The generator is 2200 volt, 3-phase, 60-cycle standard type, and was supplied and installed by the Canadian Westinghouse Company. The main leads are 3 conductor, No. 6 B. & S. lead covered in 1½-in. conduit, with potheads. The field and exciter leads are also in conduit. The generator is connected to the engine by a flexible coupling of the usual belt type.



Plan of Salmon Arm new Electric Plant.

The switchboard consists of one combined generator and exciter panel, and three 3-phase feeder panels. It is of Blue Vermont marble, and presents a fine appearance. A watt hour meter on the generator panel totalizes the station output.

The outgoing lines are temporarily in open wiring, but it is intended to ultimately use lead cable in conduit. At present one 3-phase, 2200 volt line and one 1-phase, 2200 volt line leave the building. The former is for city light and power. Pole type transformers supplied by the Canadian Westinghouse Company connect with the 110 volt secondaries. The mains consist of No. 6 and No. 8 w.p. wire, arranged for best voltages. The other circuit is No. 8 w.p. and has 52 series, 200 watt, Canadian Westinghouse street lamps hung from messenger wires spanning the street.

The building is of brick and was built by Weedon & Talbot, of New Westminster. It is large enough to accommodate another unit of similar size with the necessary extended switchboard. At present this space is occupied by store rooms and operators' quarters, which will ultimately occupy space at the rear of the power house building.

The overhead line work was installed by Mr. W. F. Buchan, local electrical contractor, who put in all station wiring and connections. The usual full load tests were put on the electric plant, and all apparatus proved satisfactory. In October, 1913, the plant was put into commission, and the operation, considering the very light city load, has proved very satisfactory. The engine is very much underloaded, and operates on two of the three cylinders which is a severe condition. The fuel now in use is Star Fuel Oil, and circulating water is obtained from the new waterworks system.

The design and supervision of both electrical and waterworks systems were in charge of DuCane, Dutcher & Company, Mr. W. E. Machan being resident engineer. This firm will also have charge of the sewerage system when it is installed.

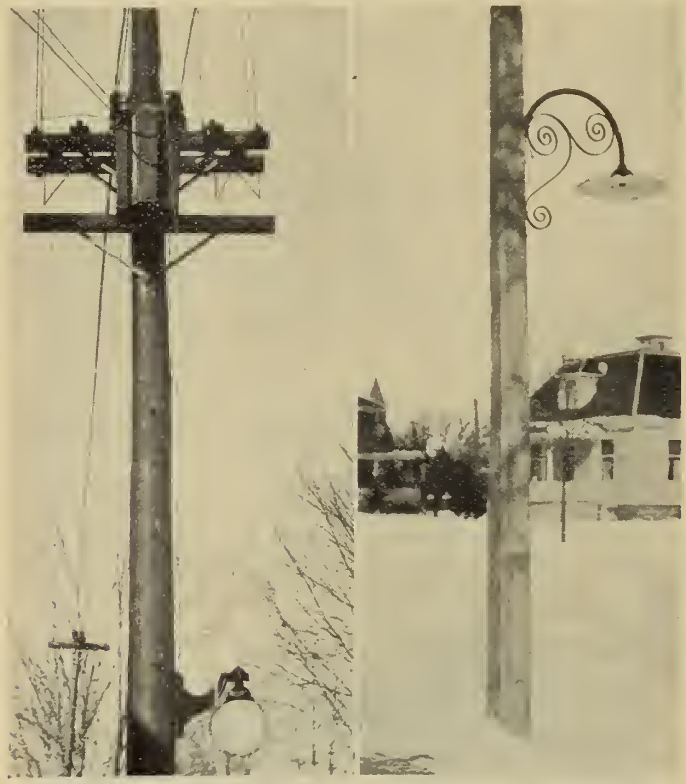
New Municipal Plant in Forest

On the 22nd of December, 1913, the old electric light plant, purchased by the town from Messrs. Hamilton & Prout, was closed down, and the new Municipal System put in operation. Although the by-law authorizing the building of the new plant was passed in 1911, construction was not, for various reasons, commenced until the first of September last. The Board of Arbitration fixed the value of the old plant at $4,600. After the payment of the purchase price in May, 1913, the service was continued by the former owners, who received all receipts and assumed all operating expenses.

Power House, Forest, Ont.

The new plant, which cost $25,000, is throughout one of the best example of modern construction to be seen anywhere in a town of like size. The power house is a concrete block building 45 ft. x 45 ft., Fig. 1, and is divided into four parts—boiler room 43 ft. x 22 ft., engine room 20 ft. x 14 ft., pump room 20 ft. x 14 ft., and transformer room 20 ft. x 13 ft. The transformer room is, at present, used as an office, pending the coming of hydro power. The pump room is used for the storing of supplies (the waterworks by-law has not yet been submitted). The chimney is of radial brick construction 90 ft. high and was built by the Alphons Custodis Chimney Company of New York City. The steam plant consists of two Leonard horizontal, tubular boilers, 16 ft. x 60 in. and a Dakin open-feed water heater, 11 ft. by 46 inches. The boiler feed is pumped from an artesian well by a motor driven bulldozer pump to a steel storage tank.

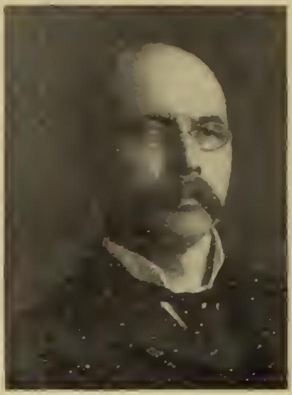
The engine is a Leonard vertical, two crank, high-speed, compound of the enclosed type; forced lubrication; speed 500 r.p.m.; size 10 in. by 15 in. by 8 in., 105 B.h.p.—direct connected to a 70 kw. Westinghouse 2200 v. 3 phase, 25-cycle generator. The switchboard consists of a Westinghouse standard generator panel and one street lighting panel. Two switchboard integrating wattmeters mounted on sub-panels record both total and street lighting loads. The line is exceptionally well designed and constructed. The streets of the town are lined with trees of such growth that the name of "Forest" is particularly fitting. The primary system is accordingly restricted as much as possible. 2,200 volt wires are carried on 40 ft. poles of Western cedar, painted and stepped. The secondary system is, for the most part, on 24 ft. concrete poles and is in 220 and 110 volt, three-wire group net work. Four point secondary vertical work on the Peirce racks is carried out on all cedar poles. All neutrals are grounded.



Type of overhead work and lighting fixtures, Forest.

The street lighting is in multiple with separate primaries. 120 brackets are so far installed, 40 of the Paris type, with 12 inch opal ball, and 80 of the Brantford type with radial reflectors. The brackets were supplied by Messrs. A. H. Winter Joyner Company. In the business section, the Paris brackets are mounted on every pole, and, at night, the lighting presents a very brilliant appearance. The council has adopted a rule which provides for the installation of extra brackets not on the original plan, when asked for, by the petitioners meeting the cost of the installation, no charge being made for current. This rule has been taken advantage of by the citizens on several streets and Prince, a residential street, in particular, is equipped from end to end with Paris type brackets on every pole.

In order to hasten the development of the plant to a self-sustaining position as rapidly as possible, inside wiring at cost has been done from the outset, by a staff of wiremen. This has resulted in almost doubling the number of consumers. At present, the number of users totals 230 and the list is growing daily. All services are metered, at a rate of ten cents per kw.h. net. The service is from dusk to daylight.



Mr. H. J. Pettypiece.

Mr. W. R. Reynolds.

The power house equipment was designed by Mr. E. J. Philip, city electrical engineer of Brockville. The construction of the plant was carried out by Mr. W. R. Reynolds, formerly of Ingersoll and St. Mary's, who rebuilt the Orillia redistribution system last year, and the entire work had the careful supervision of a progressive council under the leadership of Mayor H. J. Pettypiece, ex-M.P.P.

Forest is a growing town of 1,500 population situated in the midst of a fruit and agricultural country which is unsurpassed. The new electric light system should prove a valuable asset.

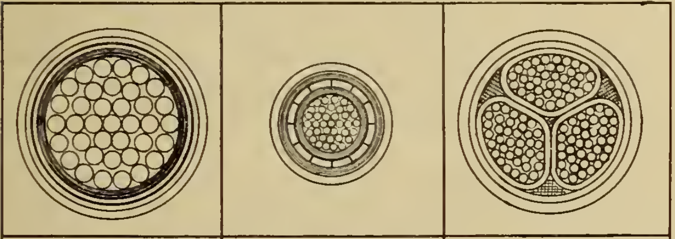
Elapsed Time Recorder

Modern hospitals are demanding that an accurate record be made of the time required for a nurse to answer each call. Only by means of an automatic recording instrument can the superintendent have correct supervision of the attention given to patients at all times of the night and day. For this purpose the Elapsed Time Recorder has been designed by the Holtzer-Cabot Electric Company. This instrument perforates a strip of paper which travels ahead a certain definite distance each minute, thus recording the exact time and the exact number of minutes elapsing between the instant the patient sends the call, and the time it is answered by the nurse. The recorder requires only slight additional wiring, as the same wires which operate the superintendent's annunciator can be used. The paper roll is of sufficient length to give a continuous record of fifteen days, and can be readily renewed in a few seconds. The mechanism is mounted on a heavy, one-piece brass base, and cannot be thrown out of adjustment or fail to work because of moisture, vibration or changes in temperature. The recording pins make a separate hole for each elapsed minute, thus making a clear, permanent record in the paper. The recorder is made in units of twenty-five stations capacity each. As many of these twenty-five station units as desired may be operated from one master clock.

Aluminium vs. Copper Insulated Cables

By Mr. E. V. Pannel*

For several years past the street railway system of Paris has been operating with low tension feeder cables of aluminium. This practice has been attended with very successful results so that considerable extensions which were made to the system in 1913 also utilized aluminium as the conductor, realizing a net economy of about eight per cent. on the cost of copper cables. The cables in question are mainly of the paper-insulated lead covered and armoured type laid in channels under the sidewalk. Developments in this direction in Europe have not been confined to Paris, however, as a paper read by Mr. D'Hoop of the Brussels Street Railway System at the end of 1912 showed that eight different street railway concerns in France, Germany, Switzerland, Belgium and Denmark were using insulated cables of aluminium. In addition to these several English traction and utility corporations have installed underground aluminium cables for almost every type of service. Not only the simple single core cable has been manufactured in aluminium, but double and triple concentrics, also the interesting clover-leaf form of three core conductor for voltages from 600 up to 6600. Quite recently the British Alumnium Company supplied a quantity of the latter at a price which showed a saving over copper, with the heavier metal at a base price of about 17c. A few typical aluminium cables for low and high voltage are shown in Figs. 1 and 2 respectively. These are reproduced merely to show that practically every form of cable has been manufactured in aluminium and that the metal is by no means restricted to heavy low tension cables, although these form by far the larger proportion of the aluminium cables in use.



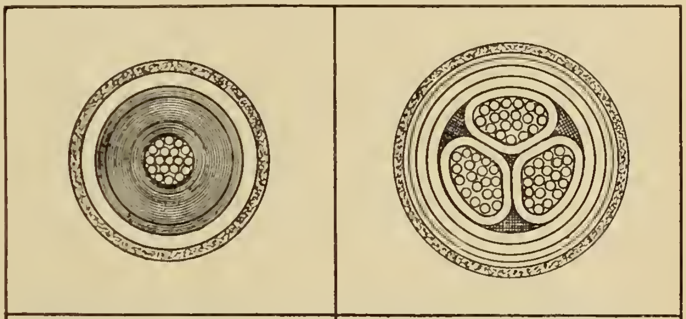
SINGLE-CORE CABLE	CONCENTRIC CABLE	THREE-CORE CABLE
Area cir. mils 1.650.000	Area: cir. mils 2 x 320.000	Area: cir. mils 3 x 610.000
Thickness Insulation ·118"	Thickness Insulation ·10"	Thickness Insulation ·125"
" Lead 2 x ·06"	" Lead ·09"	" Lead ·125"
Resin oil between Lead Sheaths Jute and Compound ·09"		

Fig. 1.—Low tension, paper-insulated cables, with Aluminium cores.

The test of economy is, however, the true one wherever a new departure is entered upon and it is obvious that aluminium cables can only compete with copper where the relative prices of the two metals make aluminium worth while. Previous to October, 1914, the price of aluminium in this country was not such as to make it a good proposition for insulated cables, except when the copper market was abnormally high. Under present circumstances, however, the light metal is quoted at prices which show about 25 per cent. advantage over copper, considering the wire base to be about the average figure for the latter metal. During the year 1913 the average monthly price of electrolytic copper wire billets f.o.b. New York was 15½ cents per pound. Allowing a fair differential for rolling and drawing this represents a wire base of 17c. Aluminium wire can be bought at a figure of 24 to 25 cents. Taking the mean of 24½c the relation between the costs of the bare wire will be:

Aluminium, 1 lb. at 24½c	24½c
Copper, 2 lb. at 17c.	34c
Difference	9½c

The above computation makes allowance for the physical properties of the metals. Copper is 3.3 times the weight of aluminium, but the latter has only 60 per cent, conductivity; the ratio of weight for a wire of given resistance per foot is therefore slightly more than two to one in favor of aluminium.



SINGLE-CORE CABLE	THREE-CORE CABLE
Area cir. mils 198.000	Area. cir. mils 3 x 248.000
Thickness Paper Dielectric ·512"	Thickness Paper Dielectric ·197"
" Lead Covering ·138"	" Lead Covering ·118"
" Jute Serving ·118"	" Steel-Tape Armoring ·120"
	" Jute Serving ·090"
Voltage 30.000	Voltage: 6600

Fig. 2.—High tension, paper-insulated cables, with Aluminium cores.

Under the above conditions it remains to be seen to what extent the saving of 9½c will be taken up by the cost of insulating and lead covering the larger diameter aluminium cable. In Fig. 3 is shown the cost of stranding, insulating and lead covering cables for pressures of up to 660 volts. Allowance has been made for material (taking lead at 4c) labor and a reasonable profit. Figuring out a concrete instance—that of a 600,000 c.m. copper cable, we get the following:—

	Copper	Aluminium
Size in c.m.	600000	1000000
No. strands	61	91
Diameter each wire	.099 in.	.105 in.
Diameter core	.893 in.	1.150 in.
Thickness dielectric	.100 in.	.120 in.
Thickness lead	.100 in.	.120 in.
Outside diameter	1.293 in.	1.630 in.
Weight core per foot	1.85 lbs.	.925 lbs.
Base price	17c	24½c
Cost core per foot	31.4c	22.7c
Cost insulation and manufacture.. ...	16.0c	23.0c
Total cost of cable	47.4c	45.7c

On the aluminium cable in this instance a saving of about $90 per mile is affected. This is, however, considerably less than the economy which frequently results from using aluminium. Larger sizes of cable such as are employed for railway feeders are cheaper to manufacture and show a relatively larger profit in aluminium. The price of copper, too, is by no means always as low as the figure assumed in this calculation, so that according to the market aluminium cables will show a greater or less saving than that indicated above.

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*British Aluminium Company, Toronto.

As a writer in the American Metal Market (March 2, 1914, p. 4) has pointed out, the growth of the electrical industries is calling for increased quantities of copper far out of proportion to the production of the metal and unless a substitute be forthcoming there is reason to expect sooner or later considerable advance in the present market quotations for electrolytic metal.

The subject of aluminium and copper cables was admirably dealt with by Mr. B. Welbourn in a paper read before the London Institute of Mining Engineers in June, 1913. His conclusions were based upon extensive experience in the manufacture and supply of aluminium and copper cables and the diagram (Fig. 4) has been reproduced from figures given by Mr. Welbourn. This shows that for a particular size of cable (380,000 cir. mils copper) aluminium begins to be cheaper when the market price is 24½c and at the average figure aluminium cables show 8 per cent. economy. This is for a relatively small size of cable for mining work; larger conductors for railway feeders would show a larger margin

The foregoing has perhaps sufficed to show that for ordinary low tension paper lead cables, aluminium is a conductor deserving of consideration from the economic standpoint. In the field of extra high tension work, however, the case is different; here aluminium possesses technical advantages. Experience with overhead high tension lines goes to show that there is a ratio of voltage to conductor diameter which cannot be exceeded without giving rise to corona loss. A similar phenomenon takes place with underground cables and aluminium was chosen for the core of the 30,000 volt cable shown in Fig. 2 for this reason. In any high tension cable of this kind the steepness of the potential gradient in the dielectric is given by the formula:

$$\frac{V}{r \log (r + d)/r}$$

where V — effective voltage.
r — radius of core.
d — thickness dielectric.

Naturally if r is increased d may be diminished and the same potential gradient maintained. Aluminium is effective in that it has a value of r which is always 30 per cent. in excess of copper, so that it necessitates less insulation and a correspondingly cheaper cable.

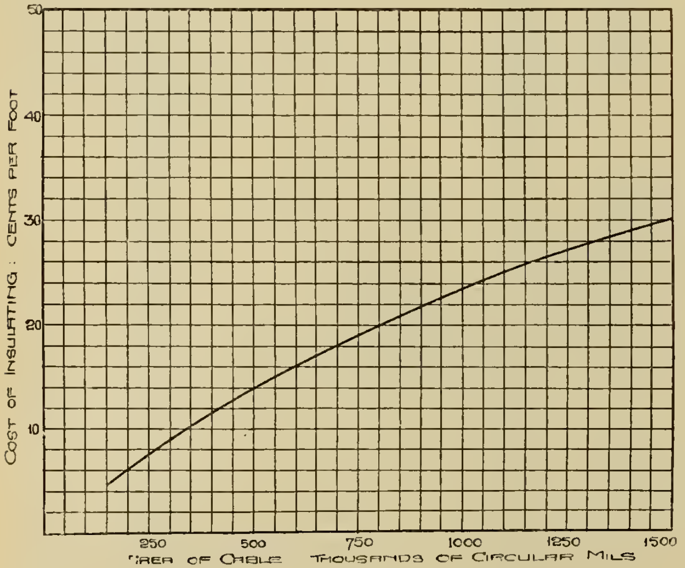


Fig. 3.—Approximate costs for insulating and covering low-tension cables.

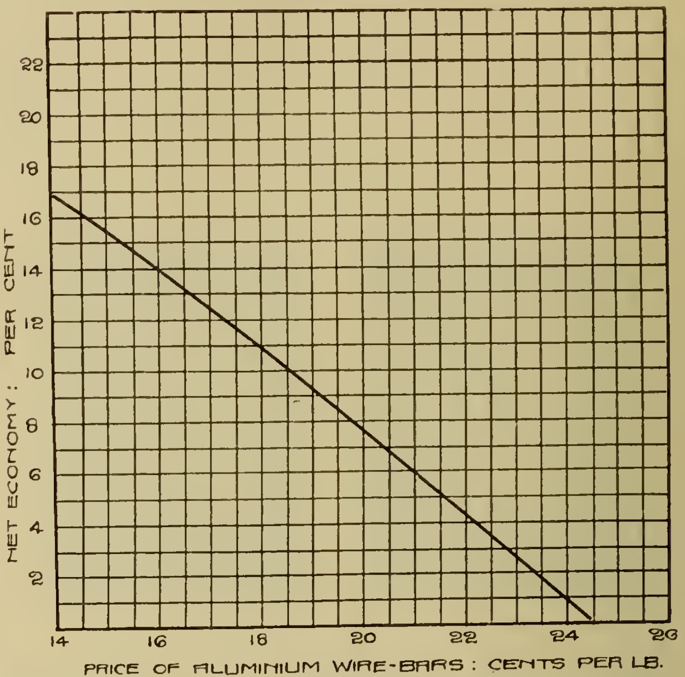


Fig. 4.—Welbourn's values for net saving effected by aluminium paper-insulated lead-covered cables equivalent to 380,000 c.m. copper, assuming the market price of electrolytic copper to be 15.5.

The practical problem in connection with aluminium are mainly those of jointing. No really satisfactory solder being available it becomes necessary to employ clamp-joints; the facility with which surfaces of aluminium bite into one another renders these particularly effective, however, and tests made after several years service demonstrate that this type of connection is no more liable to deterioration than a soldered one. The current for some of the most important suburban railroads in the vicinity of Paris is fed through clamp-joints of the simplest form with perfect satisfaction. The British Aluminium Company has developed out an improved style of stepped clamp of which a typical pattern is shown in Fig. 5 and this represents one of the most satisfactory forms at present in use. The contact resistance is reduced to the minimum and the size and disposition of the bolts renders the joint a particularly quick and easy one to apply.

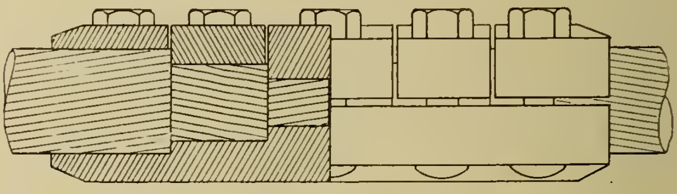


Fig. 5.—Stepped clamp as employed for through joint on Aluminium cables.

Prior to leaving for a three months' trip to Europe, Mr. R. F. Jones, the Montreal manager of the Bell Telephone Company, was presented by the staff with an illuminated address and fitted travelling bag. The presentation was made by Mr. J. A. Anderson and Mr. H. J. Neill at a concert given in honour of Mr. Jones. At the same time presentations were made of the cups donated for competition in the Inter-Department Hockey League. The cup donated by Mr. G. E. Higgins, division plant superintendent, was presented to the maintenance men, while Mr. J. A. Anderson's cup was handed to the ladies' team of the main exchange.

Westinghouse, Church, Kerr and Company, of Montreal and New York, have been retained by the Canadian Pacific Railway Company as engineers to investigate the matter of the proposed electrification of the new double-track, 5½ mile Selkirk Tunnel in British Columbia. The investigations will cover in general the type of system to be installed, the relative economies of steam and water power and the effect of the electrification upon operating conditions.

Steam Prime Movers for Electric Generators

By Mr. G. Percy Cole, M. Sc.

For the conversion of heat into mechanical work, in which the working substance is water and water vapor, various types of steam prime movers have been developed.

Undoubtedly the greatest advance in machines operating through the agency of steam, since the days of James Watt, has been the invention and development of the rotary principle to the production of motive power by means of the steam turbine. The invention of the steam turbine has in fact revolutionized not only marine engine practice, so far as fast vessels are concerned, but has also practically superseded the reciprocating engine for all large units used on land. While of very low efficiency as at first constructed, the steam turbine has been gradually improved until high mechanical efficiencies of conversion have been reached. Especially is the turbine valuable in the production of large outputs and in taking advantage of high degrees of vacuum. Apart from the many desirable features of the steam turbine such as small floor space, low maintenance, etc., the outstanding advantage is the rotary principle. The electric motor, with its one moving element, giving its power in a rotary form, is displacing all types of small engines. The time will come when all stationary motors will be electric, due to the recognition of the advantages of the continuous rotary motion with the uniform angular velocity and resulting simplification.

The various forms of reciprocating steam engine at present in use can only be looked upon as a passing stage in the development; and so soon as an equally efficient machine for any particular purpose is brought out, it must surely displace the reciprocating motor. For proof of this one has only to consider the case of the prime movers for the auxiliaries of any large modern central station. At the present time in large power houses, practically every operation which is not performed by electric motor-driven apparatus is carried out by means of steam turbine outfits. Auxiliaries such as forced-draft fans, boiler feed pumps, condenser circulating and air pumps are developed for steam turbine drive; in some cases direct, in others through the intermediary of gearing. The fact that both the steam turbine and the centrifugal pump are inherently high speed machines, has contributed largely to this application; and the advances in the design of centrifugal pumps in recent years have been such that it is now almost impossible to find a pumping proposition that cannot be economically solved by a steam turbine motor.

While it is well recognized that the market for the reciprocating steam engine is diminishing with each successive inroad of the steam turbine, nevertheless it is still with us; and before considering the steam turbine, the various commercial forms of the reciprocating motor as met with in modern practice will be briefly discussed.

I. "Marine Type," Vertical, Enclosed, Automatic High Speed Engine

The "Marine Type" is probably the simplest form of reciprocating engine met with to-day. It is largely used on steamers and in small plants on land where a low first cost is the prime consideration, and where a high degree of economical operation is not essential. It is usually built for steam pressures of from 70 to 140 pounds, and operates non-condensing. It is only built in small units, from 4 to 35 kilowatts being the usual capacities. The engine is enclosed, and is provided with automatic lubrication. A small flywheel with automatic flywheel governor is always provided; and the sub-base of the engine is extended to receive the generator to which it is connected by means of a flanged coupling. As the capacities are small, and the outfits used only for local lighting, the generators are usually 125 volt, two wire direct current machines.

Fig. 1 gives the investment costs and speeds of a line of such outfits, the figures being for complete set (engine and generator) installed in the vicinity of the large cities of eastern Canada. Figures cover set only, no piping, foundations, cables or switchboard being included.

When operated at normal speed, and at an initial steam pressure of 100 pounds per square inch, the steam consumption in pounds of steam per kilowatt hour at full load will range from 68 lbs. in the smaller capacity to 49 lbs. in the largest unit.

The demand for the "Marine Set" comes largely from the builders of the smaller river steamers, contractors' plants, and plants in small sawmills and factories.

II. Automatic Horizontal Side Crank Reciprocating Engine

This type of engine is still a favorite with many users and is too well known to require any description. It is very suitable for direct connection to electric generators, has only two bearings, and since the flywheel is placed next the generator, the twisting strains caused by it are not transmitted through the crank. This engine finds its greatest application in capacities of from 35 to 150 kilowatts. It is usually designed for 100 to 150 lbs. steam pressure, and is generally operated non-condensing. It is largely used in factories for miscellaneous power and lighting service, and

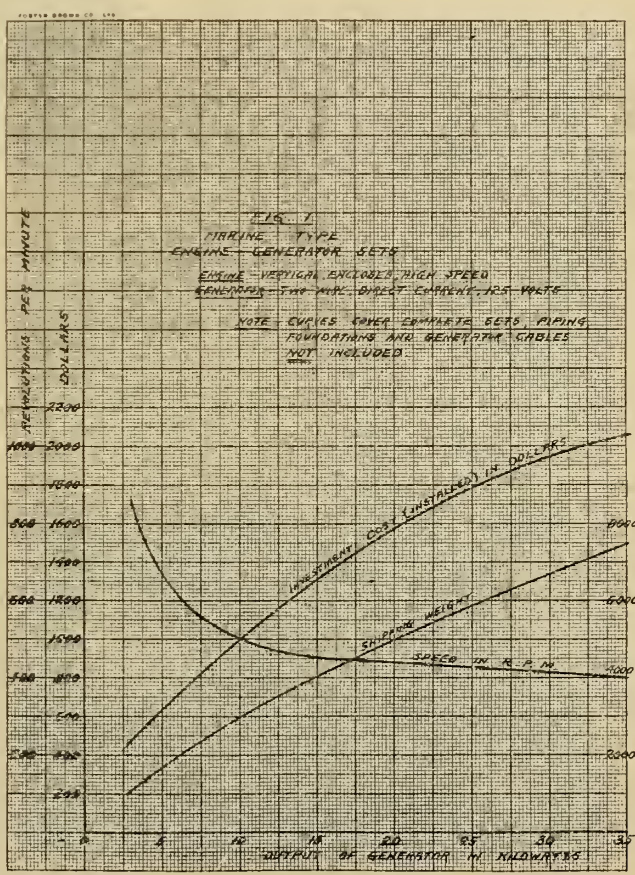


Fig. 1—Marine type engine-generator sets.

as the transmission distances are not great, it is usually connected to direct current generators of 125 or 250 volts.

Fig. 2 gives curves of investment costs (installed) and approximate speeds for complete sets of this type, the generators being of the two wire type, either 125 or 250 volts. Very often the generators are of the three-wire 125/250 volt type, which will increase the cost of the set about 7½ per cent.

When operated non-condensing at normal speed, and at an initial steam pressure of 150 lbs. per square inch, the steam consumption in pounds of steam per kilowatt hour at full load will range from 50 lbs. in the 35 kw. size to 42 lbs. in the 150 kw. capacity.

III. Vertical Enclosed Compound High Speed Reciprocating Engine

The so-called "High Speed" vertical engine, as first developed in England, has now been a favorite in Canada for several years. The small floor space required and the smoothness and quietness of its running are among its unique features. When operated condensing as is usually the case, it is very economical in steam consumption. It is built in a large range of capacities, but is generally used in sizes from 100 to 500 kilowatts. While in the smaller sizes the cost of the engine itself is practically the same as the equivalent capacity horizontal side crank engine, on account of the higher speed it enables a much smaller dimensioned (and consequently cheaper) generator to be used. In fact the saving on the cost of the generator due to the higher speed is often the controlling factor in settling on the vertical set instead of the slower speed type.

The vertical high speed enclosed engine, with either direct current or alternating current generator, makes an exceedingly compact outfit, and is largely used in factories and the medium sized steam power plants throughout Canada. On account of the small outside dimensions of these sets, they find a great field in the power plants of large office buildings and public institutions, where the architect rarely leaves sufficient floor space for the plant equipment. Steam pressures from 120 to 150 lbs. are the general rule, and condenser equipment is usually provided.

Fig. 3 gives curves of investment costs (installed) and approximate speeds for a line of engine driven units, including direct current generators of the two-wire type of 125, 250 or 550 volts. Three-wire 125/250 volt generators will add approximately 7½ per cent. to the cost. A line of sets equipped with alternating current generators instead of direct current will not differ greatly from the prices given in the curve of Fig. 3; only it will be necessary to provide for the additional cost of a suitable exciter for the a.c. machine.

The steam consumption, including steam used by auxiliaries, based on 150 lbs. steam pressure, and vacuum of 26-in. referred to 30-in. barometer, for full load operation, will range from 30 lbs. per kilowatt hour for the 100 kw. size to 22 lbs. for the 500 kilowatt capacity.

Vertical high speed engines have been developed above 500 kw., but when these larger capacities are under consideration it will usually be found that the steam turbine will be the logical machine to adopt.

IV. Corliss Slow Speed Reciprocating Engines

As mentioned previously, the demand for the large slow speed reciprocating engine is falling off very considerably of late years. The slow speed necessitates a very large generator, and the massive foundations and large amount of floor space occupied by a unit of this type are among the many disadvantages. It is true that under the stimulation of competition from the steam turbine, there have been important developments in the large reciprocating engine. The developments referred to are found in the engines of the Stumpf and the Lentz designs, and take the form of reduction of clearance and condensation losses. As the low investment cost of steam turbines will be the main factor in preventing the extensive use of these slow speed types of reciprocating engine, they will not be further discussed here.

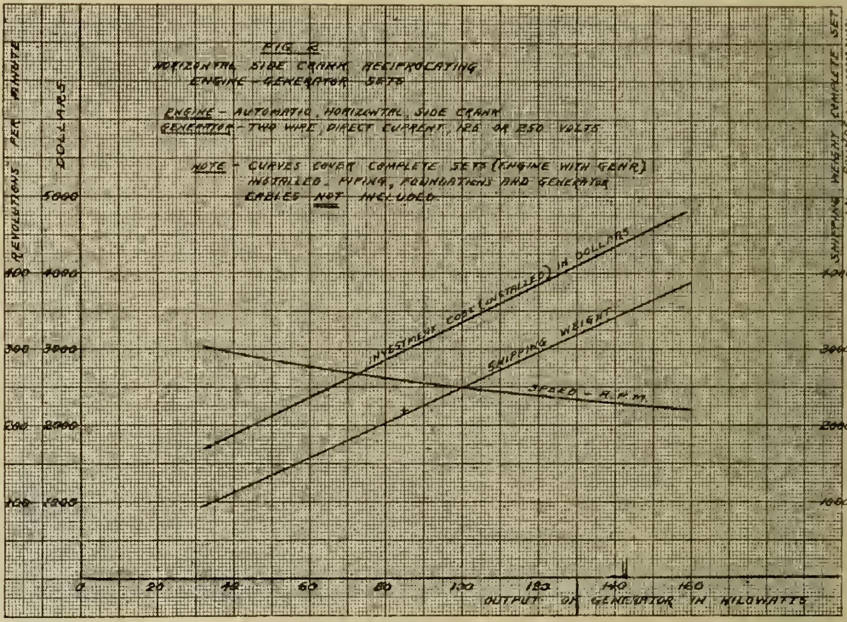


Fig. 2—Horizontal side crank reciprocating engine-generator sets.

V. "Locomobile Type."

A special form of high efficiency combined engine and boiler plant known as the "Locomobile," which has been in use in Europe for several years, has now made its appearance on the American market. It is composed of an internally fired boiler, tandem compound engine, superheater, reheater, feed water heater and pump, with or without condenser, and can be made suitable for direct connection to electric generator through a flexible coupling. The high pressure cylinder is located in the smoke flue and the jacket of the low pressure cylinder forms the steam dome for the boiler; which, together with the use of high superheats and internally fired boiler, results in very good economy of operation. Depending on the quality of fuel, a kilowatt hour can be generated on 1¾ to 2½ lbs. of coal. In this type of engine, it is customary to guarantee the performance of the unit from coal input to power output. In fact, one firm in the United States manufacturing this type of plant gives a $10,000 bond that the low fuel consumption guaranteed by them will be fully met in actual operation.

The sizes range from 75 to 600 horse power (50 to 400 kw.), and since the economy is on a par with gas engine performance, there may be a considerable demand for this class of unit among the smaller power users where a high economy is desired. The "Locomobile" has not made sufficient inroads so far in Canadian practice to allow of figures for investment costs being introduced. The consensus of opinion in the United States seems to be that this new type of prime mover is not making inroads upon any market except that of the reciprocating engine; which market is gen-

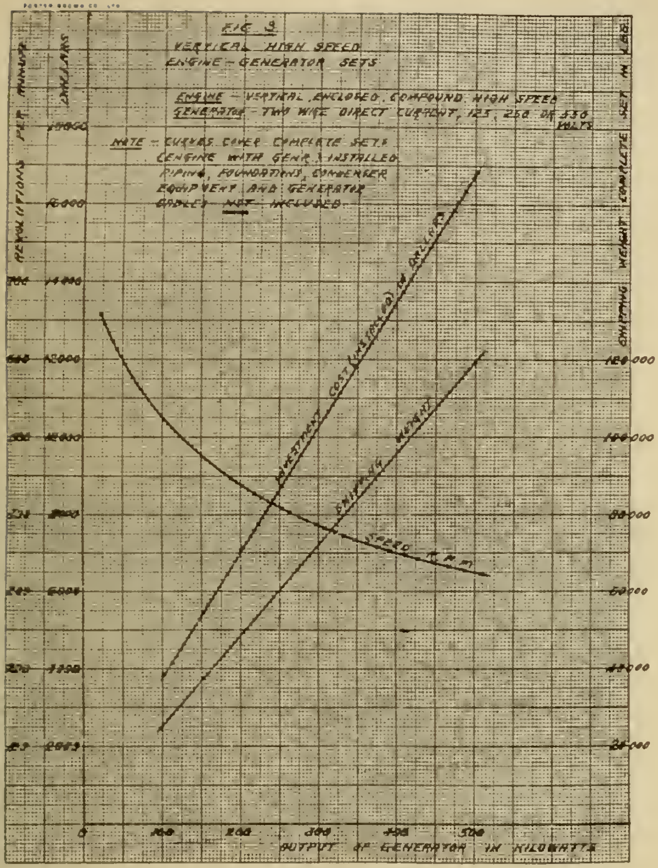


Fig. 3—Vertical high speed engine-generator sets.

erally acknowledged to be growing smaller with each successive year.

VI. Steam Turbines

Steam turbines differ from all other types of steam engine in the fact that their action involves a double transformation of energy. The heat energy present in the steam is first employed to set the steam itself in motion, imparting to it kinetic energy; and this in turn is employed to do work on the turbine blades. In utilizing the kinetic energy of steam in a steam turbine, if the whole heat drop is allowed to give kinetic energy to the steam in one operation, as in the De Laval nozzle, a velocity of about 4,000 feet per second has to be dealt with. To take advantage of a jet in the most efficient manner in a turbine consisting of a single wheel, the velocity of the buckets against which the stream impinges should be nearly one-half the velocity of the stream.

But a peripheral velocity, approaching 2,000 feet per second is impracticable. Aside from the difficulties involved in gearing down to such speed as would allow of the power being utilized there are no materials of construction fitted to withstand the force caused by rotation at such a speed.

Hence it is advantageous to divide the process into stages. This may be accomplished by using more than one wheel to absorb the kinetic energy of the jet, as in the Curtis turbine, or by dividing the heat drop into many steps, making each of these so small that the steam never acquires an inconveniently great velocity, as is done in the Parsons type. Turbines which employ one or other of these two methods, or a combination of both, achieve a greater economy of steam than is practicable with a single wheel.

The use of the single expansion single wheel type of turbine (De Laval) of course involves gearing down before the motion is applied to useful purposes. Heretofore this type has had its greatest field in small capacities; but the recent improvements in the design of double helical gearing to transmit large powers, is bringing this type to the fore in large units. Compared with the Parsons type, it lends itself well to work where small amounts of power are desired; and in such cases tests have shown very good steam economies. A 63 h.p. De Laval turbine used with a condenser has shown an average steam consumption of 20 lbs. per brake-horse-power-hour. In large sizes, however, the Parsons type is much more efficient.

From 500 kilowatts up, the type of turbine that has had its greatest application in this country is the horizontal unit of the reaction (Parsons) type, or the combination impulse and reaction (disc and drum) type. The vertical type has never been a favorite in Canada, and is not being specified for any new stations; the largest firm manufacturing this type in the United States having now developed the horizontal unit.

The following remarks will apply only to the Horizontal, Multiple Expansion, Parallel Full Annular Flow "Reaction" type, or the "Impulse-Reaction" type mentioned above. Practically any output desired can be obtained with this class of turbine. Units of 35,000 kw. normal rating are in successful operation, and 50,000 kw. capacity would be forthcoming if there was a demand for such a unit. The wisdom of adopting a unit of over 50,000 kw. can be questioned; as it would seem to be a case of putting all your eggs into one basket. Turbo-generator units of from 500 to 10,000 kilowatts are the ones usually met with, and in Fig. 4 is given a curve of investment costs in any of the large Canadian cities for sets covering this range of capacities. No piping, foundations or condenser equipment is included in these figures; but figures given include installation. Figures cover generators wound for 2300 volts, 60 cycles, 3-phase. So far in Canada, there has not been much demand for 25 cycle turbo-generator units. Curve of speed shows 1800 r.p.m. for all units above 2500 kw.; and while some firms have built 3600 r.p.m. sets up to 5,000 kw., the curve gives average practice.

High pressure condensing units are usually operated at

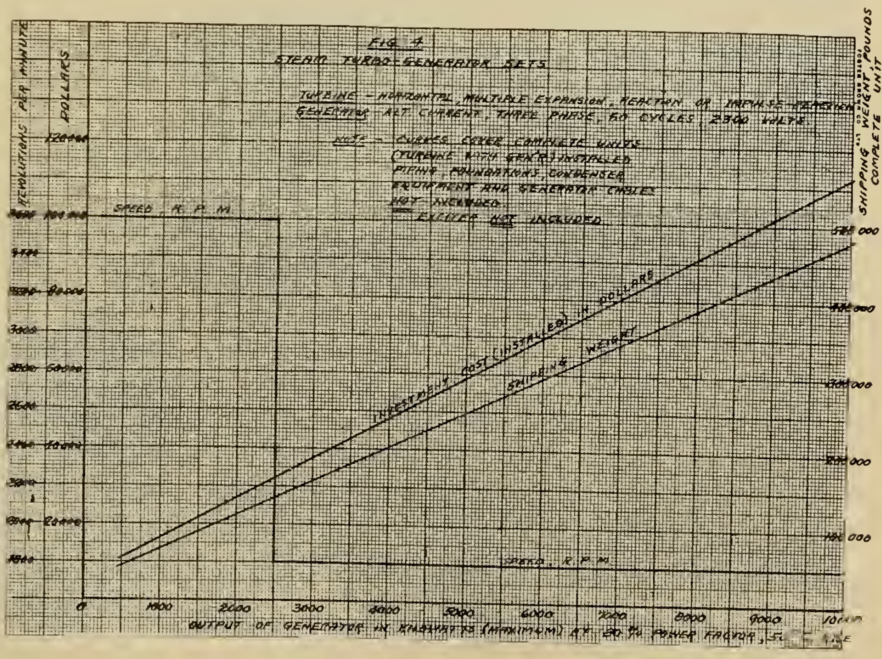


Fig. 4—Steam turbo-generator sets.

steam pressures of from 140 to 200 lbs., and with about 125 degrees of superheat. The vacuum figured on is usually 28-in. referred to 30-in. barometer. With 150 lbs. steam pressure and the above figures of superheat and vacuum, a steam consumption of about 20 lbs. for the 500 kw. size, and about 13 lbs. for the 10,000 kw. unit, may be expected. The above figures are for the rated kilowatt output at 80 per cent. power factor.

The great flexibility of the steam turbine is exemplified in the low pressure, non-condensing and bleeder types. These types are still finding a large market, principally from existing power stations; but a detailed discussion as to the special application of each type is outside the scope of this article.

Pending the developments of the gas turbine and the possible invention of an electro-chemical process of transforming the stores of energy in fuel into electric energy in a single step, the steam turbine still holds the field for all large powers. That the steam turbine has not yet reached its ultimate development, and that improvements are forthcoming, is only to be expected. Leaving aside any discussion on the mixed-vapor turbine, which type of prime mover is now receiving much attention, note should be made of the important improvements in steam turbine economy carried out recently in England by Dr. S. Z. de Ferranti; where a maximum thermal efficiency (efficiency of fuel energy to electric energy) of 29 per cent. is to be expected. When it is remembered that the thermal efficiency of the largest steam turbine units at present in existence is about 17 per cent., we get some idea of the value of Dr. Ferranti's work. The method employed by Dr. Ferranti to improve the economy is by working the steam as a gas at high temperature throughout the turbine. Unfortunately, minute details of this invention are not available; but the following extract is from Dr. Ferranti's remarks in the Watt Anniversary lecture for 1913 at Greenock, Scotland.

"In this turbine I superheat the steam initially, and after the first expansion and whilst it is still superheated, resuperheat it before it does its work in the second stage of the turbine. After this it is exhausted in a superheated condition through a regenerator to the condenser. The whole of the blading is electrically welded so as to avoid the straining due to caulking at the high temperatures that are reached and also the loosening that occurs due to the same cause. The blading is formed of mild steel with a thin coating of pure sheet nickel electrically welded on to the surface. The blading is most accurately finished to shape by a process of step by step pressing under very heavy pressure.

The blading, the sections of which are very exact, is welded in position with the accuracy of the automatic machine that is used for the purpose, and every opportunity is thus given for realizing the best results. Although the turbine is of the reaction type, no balance dummy is used. The whole of the end load is taken on a specially constructed thrust, thus saving steam leakage."

The fact, however, that a 3500 kw. machine of this new type has been running continuously for some time in supplying power to a large works with a consumption of under ten pounds of steam per kilowatt hour, augurs well for Dr. Ferranti's improved turbine.

Hydro-electric Developments in Quebec

The Pont Arnaud Plant of La Societie d'Eclairage et d'Energie Electrique du Saguenay

By Mr. E. F. Bearce, Constructing Engineer

The development of the new hydro-electric station of "La Societe d'Eclairage et d'Energie Electrique du Saguenay," is the starting point of a system which promises to be of considerable interest in the near future. While the present electrical requirements of the town of Chicoutimi are covered by 1500 h.p., plans for extensions to the pulp mills, electrification of railways and new industries call for a load of over 13,000 h.p. inside of the next five years. To meet this demand, "La Societe d'Eclairage et d'Energie Electrique du Saguenay" controls two water powers on the Chicoutimi river which will supply over 13,000 h.p., both powers being a short distance from the town.

The choice of the Pont Arnaud development for the first plant to be built, was governed by its size and ideal natural location for an economical development, being 3½ miles from the mills of the Chicoutimi Pulp Company, and on the main line of the Roberval Saguenay Railway. The other water power, known by the name of "Garneau Falls," situated about 1½ miles above Pont Arnaud, is also of ideal natural location for the economical development of 6600 h.p. in a similar way to the Pont Arnaud plant.

Source and Power of the Chicoutimi River

The Chicoutimi river finds its source in Lake Kenogami, a sheet of water 15 miles in length with a total area of 14½ square miles. This lake also feeds the River au Sable, which supplies the power for pulp and paper mills at Kenogami. To control the water supply to each river timber dams have been built, fitted with regulating gates, and the division of water is fixed by contract between the interested companies so as to send two-thirds of the water into the Chicoutimi River and one-third into the River au Sable.

The maximum flow, at flood, in the Chicoutimi River is 22,000 sec. ft. and the minimum only about 800; plans are made, however, to build a dam at each outlet of the lake which will raise the water level about eight feet more than at present and supply a mean average flow of 1300 second feet to the powers on the Chicoutimi River. Between Lake Kenogami, and the tide water of the Saguenay River, at Chicoutimi, is a distance of 15 miles, and in this distance are six water powers with a total drop of 500 ft. or about 50,000 h.p.

Port Arnaud plant, showing part of dam.

Of this amount, 20,000 h.p. is being used by the Chicoutimi Pulp Company in the manufacture of pulp. The development of the Pont Arnaud plant complete will give 6600 h.p.

The remainder of the power, about 23,000 h.p., is undeveloped, and 20,000 of this amount is within four miles of the town of Chicoutimi, Blanchette Falls with 10,000 h.p. being only two miles distant; the latter is to be developed by the Chicoutimi Pulp Company.

Dam and Forebay

The dam at Pont Arnaud is built of a solid concrete section following a high point of ledge diagonally across the river, with a length of 300 feet. This length is sufficient for a spillway at flood water with the help of a 10-ft. log sluice opening and three 5 x 5 ft. sluice gates. The sluice gates and the log sluice are built into one leg of the rectangular forebay of solid concrete, and the racks and penstock entrances are built in the other leg. All gates are equipped with hand operated hoisting apparatus of the worm gear type, so that any of the gates may be operated easily by two men. The penstocks are three in number, each 10 ft. in diameter. No. 1 penstock is installed complete, while No. 2 and No. 3 were provided with thimbles in the forebay and power house; entrances also are set in the concrete bridge under the Roberval Saguenay Railroad which passes over the penstock lines.

Step-up transformers at generating station.

Just before entering the wheel case, and inside the power house, surge tanks 7 ft. 6 in. in diameter, one for each penstock, rise ten feet above the elevation of the top of the dam. The design of the surge tank installation is shown in one of the accompanying photographs. As will be seen there, the three larger pipes rise to a common tank which is discharged through two smaller pipes 5 ft. 6 in. in diameter each, connected with the tail race.

The surge pipe and penstock work was supplied and installed by the Petroleum Iron Works, of Sharon, Pa.

Power House

The power house is 105 ft. long, by 75 ft. wide, the foundation and tailrace arches being of solid concrete construction. The superstructure, starting at the generator floor, is built up of hollow concrete blocks, 12-in. wide by 20-in. long. The blocks were made of a 1:4 mixture with the face of a 1:2 mixture, using a white cement to give a greyish white appearance to the finished work. Pilasters of the same block are built around the steel column supporting the steel work of the binding and the top is finished off with a solid concrete cornice giving additional stiffness to the walls. There are two floors in the power house, one for the generator and wheels. The other directly over the wheel cases carries the switchboard and transformer. The roof is covered with Siegwatt concrete beams, which are waterproofed with a standard paper and gravel roofing. At one end of the generator room a boiler room is located and a 15 h.p. upright boiler installed to heat the generator room, surge pipes and racks in cold weather.

Equipment

The power house is complete for all three units except the installation of the equipment of No. 2 and No. 3 units and the penstock connections to the forebay, No. 1 unit consists of a 2200 h.p. S. Morgan Smith horizontal turbine for a 55 ft. head, direct connected to a 1500 kw., 3-phase, 60 cycle, 2200 volt Westinghouse generator with a speed of 277 r.p.m. The exciter unit consists of a 175 h.p. S. Morgan Smith horizontal turbine direct connected to a 125 kw., 125 volt, Westinghouse interpole generator.

The speed regulation of the main unit is controlled by a special type of Lombard Governor. The exciter wheel is equipped with a governor of the same make.

The transformers are three in number rated at 612½ kv.a., stepping the voltage from 2200 to 12,500 for transmission. They are of the oil-filled, water-cooled type and are connected in delta on both high and low tension sides. Each transformer is enclosed in a concrete cell and mounted on trucks and rails so they may be easily moved from place to place on a small car which travels on a track in front of all the cells. The water and oil piping runs underneath the floor, directly under the transformers and are easily disconnected in case a transformer must be moved. The oil drain is connected to a common 3-in. pipe line which leads to an oil tank on the generator floor, large enough to take the oil of two transformers. When it is necessary to drain a transformer, the valve is opened and the oil runs out into the tank by gravity. To refill the transformer, a small hand pump is installed in the pipe line, which is capable of filling the transformer in about 15 minutes. The low tension busbar is made up of 1-in. diameter copper tubing, supported on post insulators mounted on the back wall of the power house, above the transformer cells. Leads are carried through the cell tops to disconnecting switches and then to the low tension side of the transformer. The high tension bus runs near the ceiling along the front of the cells; this is of 4/0 solid copper running the length of the room to the line switch cell and line outlet. All connections are made with Dossert lugs and taps.

Penstock—one in use, two others in prospect.

The generator switches are located between the first and second banks of transformers and in the same line. These are hand operated oil switches with each pole in a separate cell, and have a capacity of 500 amperes. The leads from the generator are 500,000 c.m. lead covered cables in fibre conduit.

The switchboard for the first installation consists of a panel for the main generator with operating handle for oil switch, and exciter panel with provisions for a future exciter and a line panel with provision for a future voltage regulator. The switchboard and switch gear was supplied by the Canadian General Electric Company. For lightning protection a set of electrolytic arresters are installed on the generator floor directly beneath the line outlet.

The transmission line follows the right of way of the Roberval Saguenay Railway to the sub-station which is near the property of the Chicoutimi Pulp Company, 3½ miles from the power house. The conductors are 4/0 solid copper designed to carry the full load of the complete installation. All poles are of cedar 35 ft. or more long spaced at 140 ft.

Sub-station

The sub-station is a building 40 ft. x 40 ft. built of granite masonry, the stone used being taken out in excavating for the building. A concrete partition wall divides the station into two rooms, one for the transformers, high tension wiring, and lightning arresters; the other for the switchboard, outgoing line switches and railway generators.

The equipment at the sub-station consists of two Canadian General Electric Company transformers, rated at 937½ kv.a. to step the voltage from 11,800 to 2,200. These two transformers are connected temporarily in open delta with a third compartment to place another transformer and close the delta. Room was also provided to install a second bank of transformers directly opposite the first bank when the installation is completed at the power house. The transformers are placed in concrete cells and have a similar arrangement for connections and oil and water to that in the power house. In this room is also installed a 12,000 volt electrolytic lightning arrester and a 300 amperes, 15,000 volt line oil switch in a concrete cell.

The other room of the station contains two 300 kw. motor-generator sets, which supply power for the Roberval Saguenay Railway. These machines are made up of a 425 h.p., 2200 volt, 3-phase, 60-cycle, squirrel cage induction motor direct connected to a 550 volt, compound, interpole railway generator rated at 300 kw. and running at 870 r.p.m.

Surge tank arrangement at power-house.

In connection with these machines, are two motor panels with 2200 volt, starting switches and auto-transformers, two direct current generator panels and two feeder panels. The generator and feeder panels are provided with ammeters and a volt meter; a Thomson recording watt-hour meter measures the power delivered by each machine. The power from these two machines is used to operate two electric locomotives which do the shifting in the pulp mill yard, and carry a passenger service to the main line of the railroad One of these locomotives has been in service fifteen years. It weighs 25 tons and is operated by four motors with an old rating of 75 h.p. This locomotive was supplied by the Canadian General Electric Company. The other locomotive, bought in 1912, has a total weight of 35 tons, and is operated by four motors rated at 60 h.p., built by the Westinghouse Company.

Besides the railway generators, there are in the same room three 500 amp., 2200 volts, 3-phase, oil switches and outgoing lines to the pulp mill motors and two 100 amperes, 2200 volt, 3-phase, lines to supply the town lighting and power. The output of the mill feeders is measured by a curve drawing wattmeter for each line, mounted on a panel beside the railway feeder panels. The oil switches are mounted on pipe and angle iron framework, which also supports disconnecting switches and a small panel for the operating handle and trip coils.

Mr. Xavier Ouellet.

Mr. J. G. Moquin.

The switchboard and switch gear for the sub-station and for the power house was supplied by the Canadian General Electric Company and the motor and generator sets in the sub-station were built by the Canadian Westinghouse Co.

The Chicoutimi Pulp Company has a connected load of about 850 h.p., including alternating and direct current motors of 10 to 575 h.p. The direct current motors are a part of the old system at the mill operating at 550 volts from the trolley service. These are all small motors running conveyors, wood saws and construction machinery. The alternating current equipment consists of one 575 h.p. C. G. E. Co. 2200 volt, 3-phase wound motor running at 257 r.p m. and operating pumps, screens and auxiliary machinery in the two mills.

A 150 h.p., C. G. E. Co., 2200 volt, 3-phase, 60-cycle, 720 r.p.m. induction motor operates cutting-up mill and a 50 h.p. motor runs the machine shop.

The power requirements of the town at present are for about 9,000 lamps of all kinds and 125 h.p. in motors for the several industries.

The demand for electrical energy, both at the pulp mill and in town, is constantly increasing and the electric company will soon be obliged to install the second unit at Pont Arnaud, and several motors at the mill.

The design and construction of the Pont Arnaud plant was in charge of Mr. H. S. Ferguson, consulting engineer, of New York City. Mr. J. E. A. Dubuc is president, Mr. J. G. Moquin is manager, and Mr. X. Ouellet is superintendent of the company.

The annual report of the American Telephone & Telegraph Company which is synonymous with the Bell Telephone Company of the United States shows that the number of subscribers added during the past year was 676,943 and that the total number of subscribers is now 8,133,017. The gross revenue in 1913, not including connected independent companies, was $215,600,000.

The Water Powers of Western Canada

Volume 2 of the annual report of the Department of the Interior for the year ending March 31, 1913, is just to hand. This includes information on irrigation and on the water powers capable of development at various points in Canada. The report is submitted by Mr. J. B. Challies, C. E., Superintendent of the Water Power Branch of the Department of the Interior and contains much matter of interest to the electrical and hydro-electric engineer.

The report covers, for the most part, water powers in Manitoba, Saskatchewan and Alberta, these provinces including that section of Canada concerning which least is known about the water falls. There is also appended reports which have been submitted to Mr. Challies by individual engineers on the work submitted to their charge. These include references of considerable length to the small water powers of the West, by Mr. A. M. Beale, B.Sc.; to the field organization and general work carried on under the jurisdiction of the Water Powers Branch during the past year, by Mr. J. T. Johnson, B.A.Sc.; to the Manitoba hydrographic survey, by Mr. D. L. McLean; to the B. C. railway belt hydrographic survey, by Mr. P. A. Carson; to the investigation on the Bow River district, by Mr. M. C. Hendry, B.A.Sc.; to the construction of the Coquitlam dam, by Mr. R. S. Stronach; to the La Colle falls hydro-electric development by Mr. E. B. Patterson; to the Cascade River power development by Mr. C. H. Mitchell, C.E.; to the Saskatchewan River between Le Pas and Cross Lake, by Mr. T. H. Dunn, C.E., and to the South Saskatchewan River as a source of water supply for cities and towns in South Saskatchewan, by Mr. H. E. M. Kensit.

A General Review

Mr. Challies reviews the situation in a general way and points out the policy of his department with regard to the conservation and development of the water powers under their jurisdiction. Extracts from his report follow:—

"The extensive water-power investigations on the Bow river, commenced in 1911, with M. C. Hendry, B.A.Sc., engineer-in-charge, have been practically completed, and it is confidently expected that a full report of same will be ready for publication during this year. The general results of these investigations, as outlined in Mr. Hendry's report—Part No. 7 hereto—are surprisingly gratifying, showing that it is economically feasible to so regulate the flowage of the Bow river as to warrant the development at five power sites of over 45,000 continuous 24-hour wheel horse-power, all within a thirty mile reach of the Bow river and not more than fifty miles from the city of Calgary. The results of these investigations are an unanswerable argument in favor of similar investigations being carried on by competent experienced power engineers under proper expert advice. It is hoped that the results of these Bow river investigations and their value to the public will allow closer working co-operation to be effected with the irrigation engineers in similar investigations that may be made on Alberta streams, valuable for both irrigation and power purposes. The water-power engineers solicit and welcome the fullest co-operation of the irrigation engineers—their basic aims are identical and can only be properly and fully realized by co-operation. The present use and distribution, and the conservation of the water resources of the Bow river basin constitute one of the most important problems before this department. In some of its branches this problem has already been solved, while in others it still awaits solution, although a beginning has been made and the lines of progress have been marked out. The Bow river water seems so abundant that many persons do not reflect upon its importance, or the actual limits of the supply, yet this is of the utmost moment, for upon it depends the agricultural and commercial prosperity of a very large area of southern Alberta. Every one is familiar with the wonders that have been worked in this district by irrigation—miles of desert area, almost destitute of vegetation and incapable of adequately supporting human or animal life, have been converted by water from the Bow river into fertile tracts, producing an abundance of cereals and vegetables of all kinds. This has been due alone to the magic power of water, and to obtain it tremendous labour and many millions of dollars have been expended. With the growth of industrial activity the waters of this same river have also been called upon to supply energy for transmission, many miles away, to the city of Calgary, for municipal purposes, including street lighting, tramways, etc. At the first blush, it would appear as if these two important uses of water—for irrigation and for power—would result in a serious conflict of interests, but fortunately the irrigation requirements occur during a period that the river is in flood and storage on the upper waters of the Bow river will make it possible to conserve enough of the flood waters not required for irrigation to equalize the low flow during the winter months that may be required for power purposes."

"The extensive power and storage investigations of the Winnipeg river have made considerable progress, but will not be completed for another year. The results of these investigations to date (as briefly outlined in Mr. Johnston's report, herewith) show that at six power sites on the Winnipeg river, within the province of Manitoba, over 239,000 24-hour continuous wheel horse-power can be developed, and with full regulation of the river (easily and cheaply accomplished by the Norman dam at the outlet of the Lake of the Woods and by a dam at the outlet of Lac Seul) at least 500,300 horse-power of continuous 24-hour power can be developed. Surely this spells an assured industrial future for the city of Winnipeg and the province of Manitoba."

"The policy of this department with regard to the conservation and development of the water-powers under its jurisdiction in Manitoba, Saskatchewan, Alberta, the Railway Belt of British Columbia and the Northwest Territory, has been of gradual growth, although each step has led in the same general direction—actual development without delay, control of rates to be charged consumers of power, and a rental for the use of the power, with the right to revise same. As water-powers are valuable because of their strategic position, as well as because of the flow and fall of the water, and as their adequate development generally means a very large expenditure, the means whereby the priority of right to any given power is established is a very important feature of any regulations concerning them. In this connection the principle is laid down that mere priority of application does not establish priority of right. Priority is only secured when an agreement under the water-power regulations has been entered into between the Department and the applicant for the development of the power. The agreement provides for the development of a minimum amount of power within a fixed period, not exceeding five years, for the expenditure of a stated amount of money on actual developments operations in each year, and for the issuance of a license covering the necessary amount of water and a lease for the necessary Dominion land upon the fulfillment of the terms of the agreement, the lease and license to be concurrent and for a term of twenty-one years, renewable for three further consecutive periods of twenty-one years each, and subject to cancellation upon non-fulfilment of the terms of the lease and license.

Under the present water-power regulations it has been extremely difficult to deal with applications for the development of small power projects, but regulations will shortly be in force covering small water-powers of less capacity than 200 horse-power, and it is proposed to have an experienced practical engineer make a full personal investigation of each application for the right to develop these small power schemes, with a view to rendering such engineering assistance and advice as may be possible. Most of these are projected by settlers and small mill owners, with a view to developing sufficient power to run a grist-mill or saw-mill, or for general lighting and farm purposes. In view of the practical adaptation in Ontario and the state of New York, of electricity for general labour-saving devices around the farm and for small manufacturing purposes, it would surely be a direct and lasting benefit if proper practical advice and experience were made available by the Government in connection with the many small projects throughout the West which are before this department for authorization. To meet the situation, Mr. A. M. Beale, B.Sc., an engineer of this branch has been delegated to give this matter his special study and attention. Mr. Beale will, wherever practicable, inspect each application, and where necessary will give the applicant every possible assistance in having the project carried out in a satisfactory way."

Small Water Powers

Mr. Beale's report deals with the development of small water powers having a capacity of 200 h.p. or less. It is suggested that as few obstacles as possible should be placed in the way of the development, by interested parties, of these small water-falls. It is also suggested that the form of water wheel best adapted for this size of the plant is the overshot wheel. In this connection the following extract from his report will be of interest:—

"Small water-powers merit considerably more attention than has been accorded to them in this country. In Great Britain the water-driven mill is to be seen on every hand in the country districts, flour and feed mills, saw-mills, pin-mills and so forth, furnish a local industry for the supply of local wants. In Canada the conditions are vastly different, but in Eastern Canada and the United States, where conditions approximate more nearly to those of the western provinces these small power sources are receiving attention.

It is of interest to mention here that the form of water-motor most used in England for small power purposes is the overshot wheel. This wheel is shown by Mr. C. R. Weidner of the University of Wisconsin, to be peculiarly suitable for small powers on this continent, ranging in head from 10 to 40 feet and from 2 to 30 second feet in discharge, that is to say, up to 75 horse-power. These wheels, though nearly twice as costly as turbines of the same power, have the advantage of high efficiency, reliability, adaptability to varying discharge, simplicity in construction, setting and operation, all of which compensate for an increased initial cost; further, ice troubles experienced with this form of wheel are less severe. For the development of small powers, and especially for driving slow speed machinery, the overshot wheel is worthy of attention."

The Bow River

The most troublesome characteristic of the rivers which have their source in the Western mountain range is the irregularity of their flow. For example, the Bow river has a flow as high as 45,000 second feet and as low as 500 second feet. The importance of regulation is therefore immediately evident and all the more so as the main power section of this river is within easy transmission distance of Calgary the leading city of that district. According to Mr. Hendry's report there are six considerable falls on the Bow river the most remote of which is 43 miles from Calgary. These vary in height from 44 to 70 feet and their capacities under unregulated and regulated flow are given in the accompanying table. Under proper regulation it is anticipated that the average flow could be raised to at least 1500 second feet The first two of the falls are controlled and developed by the Calgary Power Company.

Power Site	Continuous Wheel Horse power	
	Natural Flow	Regulated Flow
1 Kananaskis falls	3,820	9,545
2 Horseshoe falls	3,280	9,545
3 Bow Fort	3,600	9,000
4 Mission	2,565	6,410
5 Ghost	3,780	7,270
6 Radnor	2,800	6,400
Total	19,785	48,170

Another water fall discussed in this report by Mr. Hendry is Rock Rapids on the Saskatchewan about 75 miles west of Edmonton. As with the Bow river the greatest difficulty is with the irregularity of the discharge, which on the Saskatchewan river is known to vary between 88,000 second feet and 1546 second feet. The minimum discharge is placed at 6400 h.p. which would not justify the necessary expenditure in view of the power situation in the Edmonton district.

Among the other falls reported on by Mr. Hendry was Grand Rapids on the Athabasca. On this river the discharge varies from 110,000 second feet to 2,500. Under a 45 foot head the maximum continuous output would therefore be about 10,000 h.p. which can be increased to 30,000 under regulation conditions. The market for this power is not evident, however, as Edmonton, the closest large city, is 200 miles distant.

Cascade River Development

Mr. Mitchell's report dealt with the project for a small hydro-electric power development on the Cascade river, at the outlet of Lake Minnewanka. The water of this lake is being stored by the Calgary Power Company but arrangements were made between this company and the Dominion Government which allows the use of sufficient water by the government to develop nearly 1,000 h.p. which it is intended should be used for government purposes in the Rocky Mountains Park at Banff. The scheme of development is outlined at some length and figures are given both of cost and operation.

South Saskatchewan Water Supply

Mr. Kensit's report deals primarily with the use of the South Saskatchewan river to supply water to the various towns and cities in the south Saskatchewan district. An interesting part of the report deals with the most economical method of pumping this water. Three sources of power are available, namely, hydro-electric power to be developed in the neighborhood, power purchased from some operating company, or, power developed by fuel such as coal, crude oil or gas. Relative figures of cost under the conditions existing in that district are given on the following types of plant—high duty pumping engines; steam turbines (coal), centrifugal pumps; steam turbines (natural gas) and centrifugal pumps; water-power with steam reserve; water-power, no steam reserve; producer gas; purchased power; Diesel oil engines. The relative merits of the different plans vary, of course, with the quantity of water to be pumped and it is therefore almost impossible to come to any general conclusion from the figures submitted.

An interesting phase of the power situation was discussed by Mr. Kensit and figures given covering the relative cost of electric transmission and the cost of hauling equivalent coal. As this also only applies to the particular case considered, its general application is not definitely determined. It would appear from the figures, however, that where less than 70,000,000 gallons per day were required to be pumped the cost of carrying fuel is less than the cost of electric transmission. Where the requirements are in excess of this number of gallons the cost of electric transmission is considerably less.

Northern Manitoba

In his report on the Nelson river district Mr. Johnson takes occasion to point out the value of more definite information than is at present available regarding the water powers of northern Manitoba. With reference to the Nelson river he writes as follows:—

"The enormous resources of the Nelson river form the natural power storehouse of northern Manitoba. This river receives the run-off of the Winnipeg, Red, Saskatchewan, and innumerable smaller rivers; the whole run-off is equalized by the three large lakes, Winnipeg, Winnipegosis and Manitoba; the drop of 710 feet from Lake Winnipeg to Hudson Bay, over a series of falls and rapids, offers an enormous source of power for this district. The rapid opening up of the country due to the building of the Hudson Bay railroad will soon bring these powers within the range of commercial development, and it would be advisable that an investigation of the river be kept in view. The Churchill river farther to the north also offers a great field for power development."

Mr. Johnson's report also speaks at some length on the value of the Lake of the Woods as a storage basin. Though it is true that the Winnipeg river in its natural condition is one of the best regulated rivers on the continent it has been shown recently that the actual gaugings vary between 12,000 second feet and 52,700 second feet. Under properly regulated storage conditions a uniform flow of 20,000 and possibly 25,000 second feet could be obtained which would increase the capacity of the river from approximately 25,000 to nearly 50,000 h.p. Mr. Johnson's report covers at some length the two existing plants on the Winnipeg river, namely, that of the city of Winnipeg and that of the Winnipeg Street Railway Company. The other five principal falls are also described and their relative capacities with unregulated flow, partially regulated flow and maximum regulation given as in the table herewith:—

Site	Head	Unregulated flow of 12,000 second feet minimum	Regulated flow of 12,000 second feet.	Maximum regulation of 25,000 second feet
*City of Winnipeg municipal plant	48′	52,300	87,300	100,000
Slave falls	26′	28,400	47,400	59,000
*Winnipeg Street Railway plant .	39′	42,500	42,500	42,500
Seven Sisters (say)	40′	.....	29,100	47,400
McArthur	20′	21,800	36,300	45,400
Du Bonnet	48′	52,000	87,000	109,000
Pine	43′	47,000	78,200	98,000
		244,000	407,800	511,300

*Existing power plants.

Mr. McLean also emphasized the importance of the regulation of the Lake of the Woods and in this connection writes:—

"By proper regulation of this lake the powers on the Winnipeg river would be increased some 55 per cent., or from some 276,000 horse-power to 422,000 horse-power marketable power. This would be of great benefit to: The city of Winnipeg's Municipal Power plant, to the Winnipeg Street Railway Company's plant, to the large water-powers owned by the Dominion Government, to the Ontario Government water-powers, to the town of Kenora, to the Keewatin Power Company and to the Lake of the Woods Milling Company."

The Shawinigan Water and Power Company are issuing $1,375,000 new stock at the price of $120 per share.

Underground Telephone Cables

Underground telephone cable systems were described in a paper read by Mr. G. A. Moore, supervisor of plant, Bell Telephone Company, at a meeting of the Montreal Electrical Society on March 2nd. Mr. Moore outlined the development of the system of aerial construction, from the grounded system to the present metallic circuit system, and recounted the disadvantages which led to the use, in cities and towns, of conduits. The latter were of two kinds—the solid and the built-in, the latter being almost universal in Canada for telephone purposes. Mr. Moore also described the development of conduits, from the days when lumber was used to the present fibre duct and vitrified clay conduits. A single duct up to 9 ducts was used, although the latter was unusual. After a reference to the classes of insulated wire employed, Mr. Moore spoke of the methods of drawing in wires, and the troubles in ducts, such as ice-squeezes, burn-outs, and electrolysis. For long distance work special cables were made, although it was found that for this communication better results were obtained from aerial lines than from conduits. In Montreal about 80 per cent. of the wire used by the Bell Company for outside communication was underground. There were underground wires on 77 miles of streets, including ten miles of laterals. There were 64 towns in Canada where the company have constructed conduits. One conduit in Montreal is 10½ miles long, while another almost encircles Mount Royal. The conduits of the company were separate from those being put down by the city.

In 1913 the gross earnings of the Bell Telephone Company of Canada were $8,850,448, an increase of $1,212,144, while the net earnings of $2,215,257 were $335,072 higher and the balance available for dividend $1,793,522, a gain of $195,427. After paying a dividend of 8 per cent. there is a surplus of $503,732. The total assets are $39,798,851, an increase of $8,111,244. In the report, Mr. C. F. Sise, the president, stated that 30,918 subscribers were added during the year, the total number of telephones now in use being 223,666. The company own and operate 452 exchanges, an apparent decrease of 4 (caused by the consolidation of certain exchanges). 7,977 miles of wire were added to the long distance system in 1913. The long distance lines now owned and operated by the company comprise 72,063 miles of wire on 9,276 miles of poles, and 3,019 miles of wires in underground and submarine cables. The company have arrangements for exchange of business with 531 local organizations, serving over 65,179 subscribers. A substantial part of the company's earnings is derived from investments of the shareholders' funds, and from the use of surpluses year by year in extending and improving the operating telephone plant of the company, and the net revenue for 1913 was 6.2 per cent. upon the total investment.

The company own 223,666 stations, an increase of 30,918, while the number of connecting and miscellaneous stations is 65,562, an addition of 10,225 during the past year. The number of miles of wire is 622,548, the central stations 452, and the number of employees 8,270. The average daily exchange connections in 1913 were 1,739,388, and long distance 17,169.

The following statements show the growth of the company in five year periods:

Year	Exchanges	Number of Subscribers	Wire, in Miles	Distance Pole Miles
1885	126	10,200	3,000	2,000
1890	212	20,437	8,288	4,071
1895	345	30,908	14,851	5,884
1900	343	40,094	21,350	6,525
1905	526	82,351	37,082	8,645
1910	508	138,370	54,133	8,861
1913	452	223,666	75,082	9,276

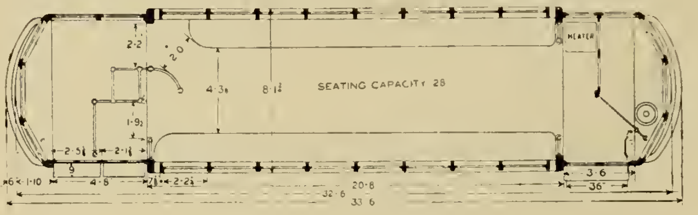
Electric Railways

Single-Truck Cars for Windsor, Ontario

An order for steel underframe, vestibule, pay-as-you-enter cars was recently completed by the G. C. Kuhlman Car Company for the Sandwich, Windsor & Amherstburg Railway, Windsor, Ontario. The cars are intended for one-way operation and are mounted on Brill No. 21-E trucks.

The side sills are formed of steel plates, 14 in. by 3-16 in. These are reinforced at the top by a 4-in. dropper bar and at the bottom, along the outside edge, by a 3-in. by 2½-in. by ⅜-in. angle which carries a 2-in. by 4-in. yellow pine sill into which the ash posts are tenoned. Additional longitudinal members are made up of channels and T-sections. The end sills are formed of 9-in. channels and the crossings consist of 5-in. channels. The platforms are supported on two center knees formed of 5-in. channels and outside knees of 4-in. channels shaped like a truss.

The roof is of the monitor deck type, with pivoted ventilator sash; side windows have double sashes, those at the top being stationary, while the bottom ones are arranged to drop into pockets. The interior is finished in cherry, with longitudinal seats upholstered in olive-green leather. These have rounded corners at each end, with pipe stanchions at the forward end. A heater is provided on the controller side of the front platform and is separated from the motorman's position by a partition, the upper part of which is panelled in glass.



Plan of new Windsor cars.

Vestibules are of the round end type, with double sash windows similar in operation to those in the car body, except for an adjustable feature on the center window at each end. The vestibules are panelled inside with sheet steel, which is cut away at the bottom to permit cleaning the window pockets.

The rear vestibule is provided with double folding doors, each section having two leaves and being arranged to open inward. These doors are operated in conjunction with folding steps by means of a mechanism controlled from the conductor's position, the latter being guarded by pipe railings as shown in the diagram.

Hamilton Incline Railway Extensions

East End Incline at Hamilton is to be supplied with important new electrical equipment. Mr. Geo. F. Webb has given the order for this equipment, as follows,—one special double fixed drum, double geared electric Lidgerwood Incline hoist; two C. G. E. 180 h.p., 550 volt, d.c. motors with special automatic control; one C. G. E. motor-generator set; one "Tudor" storage battery of 262 F. 11 cells, and one C. G. E. four-panel switchboard.

The Safety First Movement

One of the most important developments of the past two years, both in steam and electric railway work, is the Safety First movement. It has come to be recognized that fatalities are due to causes which, in many cases, are under the control of the operators, and an educational campaign has been launched in both the United States and Canada which is already having far reaching results in reducing the number of accidents.

It is true that the human factor is not the only one to be considered; much is also being done along the line of safety appliances of all sorts such as, for example, the more general use of air brakes, the use of more reliable material in the construction of machinery and in the methods employed by the men in the discharge of their duties. It is generally recognized, however, that the education of the men themselves towards a more careful and vigilant discharge of their duties is the most important feature to be reckoned with and is the line along which the greatest improvement can be made in the least time.

Nor must it be forgotten that in this educational campaign the only people who need education are not the operators themselves. The general public, and this is especially true of electric railway work, are very largely responsible for many of the accidents. It follows therefore, that a campaign of education must follow somewhat different lines on steam and electric railways. The maxim to be followed by the operators in each case, however, is the same—eternal vigilance and caution. This phase of the question was discussed in a very interesting way in a recent address by Mr. A. T. Hardin, vice-president of the New York Central lines before a New York Central line safety meeting. Mr. Hardin spoke on different phases of the safety movement, but regarding the men themselves the following remarks are of unusual interest. The New York Central goes so far as to publish a monthly magazine devoted to a discussion of this Safety First movement, of which some 80,000 copies are printed each issue and distributed among their employees. An extract from Mr. Hardin's remarks follows:—

The fourth and last element in this Safety analysis, and the most important of all, is the man element. Man, in some cases is the most certain, and in other cases the most uncertain element, with which we have to deal, and therefore involves the greatest hazard and the largest field for Safety work. This is true because we are dealing with human nature, with its many unknown racial and family traits. The railroad rank and file, as to-day constituted, probably has the best body of men of any commercial enterprise in the world. But men do not remain stationary. The service is constantly being depleted through retirement; through natural causes, such as death and illness; through changes in occupation, and through many other causes. This makes it necessary to employ annually on the New York Central lines from 5,000 to

10,000 new men. The railroads can examine these young men to see that they have the proper physique to enter the service, and can make reasonable inquiry as to their antecedents, their character and the influences at home which may tend to control them in the future. The railroad can also instruct them in the several books of rules and regulations and can exercise to a limited extent only a general watchfulness over them in groups, after employment. But, as a rule, after they have passed the awkward squad, so to speak, and entered the ranks of the railroad army of 150,000 men, the identity of many of these young men at first becomes almost entirely lost. If then a young man have a good foundation for truthfulness, honesty and for the well-recognized traits which count for honor, and if he have somewhere in him that indefinable spark of conscience, which always points out his duty, and tells him to do it; or, even if he have not all of these with him at first, but has a good railroader with him on the engine, in the caboose, in the stations or on the tracks or elsewhere, he will soon make, and will probably remain, a good railroad man, and therefore the safest element in our wonderful transportation organism. If, on the other hand, a man have concealed in him bad traits of character and have bad instructors and bad associates, he is liable to become a bad man and then more dangerous than the rottenest rail that was ever rolled.

We have among us thousands of men whose type illustrates what we mean by "Safe men." The best of them sometimes make a mistake, because it is human to err, but it is the high average of efficiency which counts. I need mention only a few specific cases to explain what I mean. The Empire State Express has run to date over six million miles, or around the world two hundred and fifty times. During that period I cannot find where an engineman or a conductor or one of their crews has been guilty of sufficient neglect of duty to have jeopardized the Safety of the passengers who had entrusted themselves to their care. The names of these men, and many others in the service who belong to a similar honor roll, are so well known to you that they need not be mentioned here. We all know what they stand for; namely, service and duty well done, which means Safety. We venture the belief that hundreds of men who have served under these men were taught their lessons and are giving a good account of themselves.

Now, these honor roll men and others like them, are not mere accidents. They have learned their profession from the careful men who preceded them, and then in turn must make the next generation of railroad men by the same process. The extent to which this is done, and the extent to which we continue it, is the measure of the degree of Safety which we shall attain. If this be true—and I think I am not mistaken—we have reached the real meaning and the ultimate significance of this so-called "Safety First" movement. We cannot escape the conclusion, nor in the end the responsibility, that we are and must be with these young men "Our Brother's Keeper."

Will Make Large Expenditures

Following out the policy of improving the system, in order to meet public requirements, the Montreal Tramways Company have decided to expend about $2,000,000 during the coming season. Last year many parts of the track were relaid and new intersections put in. The present programme includes the renewal of a large mileage, the erection of two car barns, and the purchase of 100 double truck cars. The new rails will be 116 lbs. to the yard in place of the 80 lb. rails. It is intended to gradually substitute the new trailer cars for the single type on the St. Catherine street route, the trailers having proved both popular and efficient in dealing with the heavy traffic. Two new routes are to be opened up. The company will appeal to the Privy Council against the decision of the Appeals Court, Montreal, that the Quebec Public Utilities Commission has jurisdiction over the company. The latter deny the right of the Commission to order the production of certain documents relating to the operation of the company.

Personal

Mr. H. Doughty, Superintendent of the Regina municipal street railway system has resigned, the resignation to take effect on May 1, 1914.

Mr. D. W. Houston, assistant superintendent of the Regina municipal street railway system has been appointed acting superintendent.

Mr. A. K. Bunnell will, it is understood, be acting superintendent of the Brantford Street Railway system for the remainder of the year 1914.

Mr. Charles F. Gray has been appointed consulting electrical engineer to the Manitoba Rolling Mills Company, Limited, particularly in regard to the electrical equipment for their new plant at Selkirk.

Mr. J. B. Woodyatt for many years power superintendent of the Sherbrooke Railway, Light & Power Company has resigned to accept a position with the Southern Canada Power Company in Montreal.

Mr. F. A. Gaby, chief engineer of the Hydro-electric Power Commission of Ontario delivered an address on March 21 before the Canadian Institute, Toronto, on the subject of "The Hydro-electric System."

Mr. H. D. Johnson has resigned his position with the Canadian British Insulated Company to join the engineering staff of the Eugene F. Phillips Electrical Works as assistant contracting manager. Mr. Johnson is considered one of the best authorities on underground distribution in the Dominion and is thus a valuable acquisition to the company he is joining.

Mr. C. Antony Ablett.

Mr. C. A. Ablett, who was recently appointed general manager of the Siemens Company of Canada, Limited, has had a wide experience as an electrical engineer in Europe and the North American continent. Previous to his present position, Mr. Ablett was manager of the steel works and rolling mill department of Messrs. Siemens Brothers Dynamo Works, Limited, London, England, and had charge of the installation of some of the largest electrical plants in European steel works. Prior to 1906, he was with the G. E. Company and was engaged in electrical work in Canada and the United States. Mr. Ablett has contributed papers to the Institution of Civil Engineers, the Iron and Steel Institute, and the Institution of Electrical Engineers, and was joint author with Mr. H. M. Lyons of a paper on the "Electrical Driving of Winding Engines and Rolling Mills," read March 12 before the Canadian Society of Civil Engineers and the Canadian Mining Institute. This is a subject on which Mr. Ablett speaks with special authority as, we understand, he has installed some 60 winding plants in various parts of the world. He is an associate member of the Institution of Civil Engineers, and has been awarded the Bayliss and Miller prizes of that Institution.

Illumination

Efficiency of Illuminants

By Dr. Charles P. Steinmetz[*]

When considering problems of illumination, whether it be lighting of indoor places, or of the streets of a city, the first and most important question is the efficiency of the source of light, or the illuminant.

Efficiency is not the only factor, but other features come in as essentials of a satisfactory illumination, such as:

The quality or color of the light; that is, how nearly white it is, or whether it is off color towards the yellow or the green.

The size of the lighting unit, as determining uniformity and diffusion of the illumination.

The glare or absence of glare of the illuminant; that is, the intrinsic brilliancy of the light source.

The steadiness of the light, and its sensitivity to fluctuation of voltage or current.

The characteristic of the electric circuit required for the operation, as determining the amount of station apparatus, such as constant current transformers, voltage regulators, etc.

The cost of maintenance and renewal, such as trimming, length of life of the arc lamp electrodes, useful life of the incandescent lamps, etc.

However, all this is secondary to efficiency, because defects in any of the above enumerated features can be overcome by a sacrifice of efficiency:

While a light source which is free of glare would be preferable even if of slightly lower efficiency, its inferiority in efficiency must not be much, as a light source can be freed of glare with a slight decrease of efficiency, by a diffusing globe.

Higher cost of maintenance and renewal balance against lower cost of power in the more efficient illuminant, etc.

Thus, while the other features of a satisfactory economical illuminant must be considered and balanced against light efficiency, the efficiency is economically the dominating factor.

In judging of the efficiency of light sources, two procedures are feasible:

We may secure and photometrically test all the commercially available illuminants, and base our judgment thereon. This would be the proper and only feasible way in solving an illuminating engineering problem, as when designing the illumination for a building, store, streets of a city, etc.

Such procedure would fail, however, when considering the larger problem of the development of the art of illumination, and of the possibilities of the various illuminants, as when dealing with the question whether the new high efficiency incandescent lamp will replace the arc lamp or whether the arc lamp as well as the incandescent lamp will find definite fields of usefulness. Questions of this character cannot be decided by the comparison of existing types of lamps, as these types merely represent the industrial requirements of the preceding years, and a general judgment on the possibilities of the various illuminants would almost certainly be erroneous and misleading, if based only on existing commercial types. It would for instance not include the effect of the gas-filled mazda lamp or of the titanium lamp, neither of which is yet a standard commercial product.

Thus, in judging on the possibilities of the various types of illuminants, we must go beyond the mere comparison of existing commercial lamps, and must base our judgment on the efficiency characteristics of the light giving radiator—lamp filament or arc stream—as derived from the photometric tests of lamps in commercial existence or in development.

In comparing light efficiencies, only the total light flux given by the source of light can be considered, and will in the following be given in mean spherical candle-powers (msph. c-p.), as the mean spherical candle-power is a more familiar unit than the lumen (one lumen = 4 π msph. c-p.).

The candle-power 10 deg. below the horizontal, which is of importance in street lighting, and the mean hemispherical candle-power, which is of importance in indoor lighting, are not measures of the light flux of the illuminant, and have no direct relation to efficiency, but they represent the distribution of the light flux as affected by the type of reflector, globe, etc. Comparisons based on 10 deg. c-p. or mean hemispherical c-p. characterize just as much the efficiency of the design of globe or reflector as the light flux, and thus when used in the efficiency comparison of light production, would be misleading. For instance, a European quartz mercury lamp gives 10 deg. below the horizontal the same c-p. per watt as the mazda lamp, but gives four times the mean hemispherical candle-power of the mazda lamp: its total light flux, however, or its msph. c-p. per watt, are only twice that of the mazda lamp. By a suitable reflector, the mean hemispherical c-p. of the same mazda lamp could be increased by 50 per cent. or by another reflector the 10 deg. c-p. of the mercury lamp made more than twice that of the mazda lamp, etc. Thus, depending on the reflector used, we would get all kinds of comparisons of these two lamps, when using 10 deg. or mean hemi-spherical c.p. No reflector, however, can change the total light flux, or the msph. c-p. of the light giving source, and with the same light flux and equally good design of reflector, the 10 deg. c-p. and the mean hemispherical c-p. would be closely the same also, so that the total light flux is the characteristic of the illuminant which best determines its efficiency for all uses.

Table I. gives a collection of efficiency data of the various available illuminants.

The fourth column gives the msph. c-p. per watt of commercial lamps, as based on photometric tests. Therefrom, and from other tests, are derived in column 1 the specific consumption in watts per msph. c-p., and in column 2 the efficiency in msph. c-p. per watt, of the light source proper, that is, the filament, arc or vapor stream. The values in column 2 usually are higher than those in column 4, by the amount of light which in the commercial lamp is lost in reflectors, obstructed (in the arc lamp) by the operating me-

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[*] Chief Consulting Engineer, General Electric Company.

Table I. Light Sources

Type of Lamp	Radiator		Available Efficiency; mean sph. c-p. per watt (inclusive reflector*)	Lamps		
	Specific consumption watts per mean sph. c-p.	Efficiency; mean sph. c-p. per watt		Mean sph. c-p. per watt	Mean hemisph. c-p. per watt	10° c-p. per watt
Incandescent Lamps						
Treated carbon fil., 3.1 watt hor. c-p.	3.9	0.26	0.21	0.26	0.4	0.4
Metallized carbon fil. (Gem) 2.5 watt hor. c-p.	3.1	0.32	0.26	0.32	0.5	0.5
Mazda, 1 watt p. hor. c-p.	1.25	0.80	0.64	0.80	1.2	1.25
Gas-filled mazda, 0.5 watt p. hor. c-p.	0.625	1.60	1.28	(1.60)	2.4	2.5
Melting tungsten in vacuum	0.28	3.6	(2.88)			
Enclosed Carbon Arc Lamps						
6.6 amp., 450 watt, a-c. series	2.0	0.50	0.39	0.4	(0.7)	0.5
6.6 amp., 480 watt, d-c. series	1.25	0.80	0.62	0.6	(0.9)	1.0
500 watt, d-c. "intensified" arc	1.00	1.00	0.78	0.8	1.4	
Flame Carbon Arc Lamps						
Best values of 500 watt yellow flame	0.25	4.0	3.1	3	5.6	6.2
Best values of 300 watt yellow flame	0.4	2.5	1.95	2	3.5	4
Best values of 500 watt white flame	0.4	2.5	1.95	2	3.5	4
Magnetite Arc Lamps, d-c.						
Standard 4 amp. 300 watt 250 hour	0.77	1.3	1.0	1.0		2.2
Special 4 amp. 300 watt 150 hour	0.56	1.8	1.4	1.4		3.0
Standard 6.6 amp. 500 watt 100 hour	0.53	1.9	1.5	1.5		3.2
Special 6.6 amp. 500 watt 100 hour	0.46	2.2	1.7	1.7		3.5
Titanium Arc Lamps, a-c.						
Standard 200 watt	0.42	2.4	1.9	1.8		4.0
Experimental 350 watt	0.29	3.5	2.7	(2.6)		5.4
Experimental 500 watt	0.22	4.6	3.6	(3.5)		7.0
Best values	0.15	6.7	(5.2)			
Mecury Lamps						
Best values, glass tube	0.5	2.0	1.55			
Best values, quartz tube	0.4	2.5	2			
Moore Light						
Best values, nitrogen	1.8	0.56	0.45			
Best values, neon	0.7	1.45	1.1			

*Loss by reflector assumed 20 per cent. for incandescent, 22 per cent. for arc lamps.

chanism, etc. The efficiencies given in column 2 can in general not be realized, since in directing the light flux for the distribution required by the use of illuminants—downwards in indoor lighting, and with a maximum about 10 deg. below the horizontal in street lighting—a loss of light occurs in reflectors, globes, etc. This loss is assumed equal to 20 per cent. in the incandescent lamps, and 22 per cent. in the arc lamps. These values represent about average conditions met with properly designed light distributors. Column 3 then gives the available efficiency, that is, the efficiency of the light flux directed for the contemplated use, or the "useful light flux" available with suitable reflector, etc. Columns 5 and 6 give the mean hemispherical candle-power—indoor lighting—and the candle-power 10 deg. below the horizontal—street lighting—of the lamp per watt, as given by test or estimated as available with suitable reflector, etc.

It is obvious that general efficiency comparisons of the various classes of illuminants must be based on the values in column 3, as these values represent the usefully available light flux in msph. c-p. per watt. All the following tables, except where otherwise stated, are therefore based on the values in column 3 of Table I.

A difficulty exists in comparing flame carbon arcs with each other and with other illuminants, insofar as flame carbons have no typical efficiency, but their efficiency depends on the amount of impregnation. With increasing impregnation, the efficiency increases, but other defects make themselves gradually more and more felt, as slagging and sticking, etching of the glassware, lesser steadiness, etc. In the tables are given the best values found in test, though commercial flame carbons of different types and makes are as a rule lower by from 20 to 50 per cent.

Table II. gives the relative efficiency of the various illuminants of Table I., arranged in the order of their efficiency, from the least efficient to the most efficient, irrespective of the size of the illuminant.

The limitation of this table naturally is, that the efficiency of illuminants varies with the size, or watt consumption, in a different manner for different illuminants. Thus the efficiency of incandescent lamps remains approximately constant over a wide range of sizes, while that of arc lamps increases with increasing, and decreases with decreasing watt consumption. A smaller unit of arc lamp would therefore take a lower position, and a larger unit a higher position in the table.

Table II. Relative Efficiency of Illuminants

(Irrespective of size, in available mean sph. c-p. per watt)

3.1 watt per h. c-p. carbon filament	0.21	0.4	Any
2.5 watt per h. c.p. gem filament	0.26	0.5	Any
450 watt 6.6 amp. series enclosed a-c. carbon arc	0.39	0.5	175
Nitrogen Moore tube	0.45		
480 watt 6.6 amp. series enclosed d-c. carbon arc	0.62	1.0	300
1 watt per h. c-p. mazda lamp	0.64	1.25	Any
500 watt d-c. "intensified" carbon arc	0.78		
4 amp. 300 watt d-c. standard magnetite arc	1.0	2.2	300
Neon Moore tube	1.1		
0.5 watt per h. c-p. gas filled mazda lamp	1.28	2.5	above 350
4 amp. 300 watt d-c. special magnetite arc	1.4	3.0	(420)
6.6 amp. 500 watt d-c. standard magnetite arc	1.5	3.2	750
Mercury lamp in glass tube, best values	1.55		
6.6 amp. 500 watt d-c. special magnetite arc	1.7	3.6	850
220 watt a-c. titanium arc	1.9	4.0	420
300 watt yellow flame arc, best values	1.95	4.0	[585]
500 watt white flame arc, best values	1.95	4.0	[975]
Mercury lamp in quartz tube, best values	2.0		
Experimental 350 watt a-c. titanium arc	2.7	5.4	(950)
Melting tungsten in vacuum	2.88		
500 watt yellow flame arc, best values	3.1	6.2	[1550]
Experimental 500 watt a-c. titanium arc	3.6	7.0	(1800)
Titanium arc, best values (high power)	5.2		

As 300 watts and 500 watts are representative power consumption of medium and of large light units, in Table III. and Table IV. are given the efficiencies of available 300 and 500 watt illuminants, in order of their efficiency, from the lowest to the highest.

Table III. Efficiency of 300 watt Illuminants

	Available mean sph. c-p. per watt	Available mean sph. c-p.
Mazda lamp (1 watt per h. c-p.)	0.64	190
Standard 4 amp. d-c. magnetite arc	1.0	300
White flame carbon arc, best	1.2	360
Gas-filled mazda lamp (0.5 watt per h. c-p.)	1.28	384
Special 4 amp. d-c. magnetite arc	1.4	420
Yellow flame carbon arc, best	1.95	585
A-c. titanium arc	2.4	720

Table V. then gives comparison of the watt consumption of the different types of illuminants required to produce respectively 200, 300, 400, 500 and 1,000 available msph. c-p. The values in this table are also arranged in order from the lowest efficiency, that is, the highest watt consumption, to the highest efficiency, that is, lowest watt consumption.

Many interesting conclusions can be drawn from these tables.

For instance, in Table V., 400 c-p. seems about the dividing line between high efficiency and low efficiency illuminants: The a.c. and the d.c. arc and the mazda lamp do not go beyond 400 c-p., while the flame carbon arcs, the titanium lamp and the gas-filled mazda lamp do not go below 400 c-p., and can not be produced efficiently in smaller units.

Table IV. Efficiency of 500 Watt Illuminants

	Available mean sph. c-p. per watt	Available mean sph. c-p.
A-c series enclosed carbon arc	0.42	210
Mazda lamp (1 watt per h. c-p.)	0.64	320
D-c. series enclosed carbon arc	0.65	325
Gas-filled mazda lamp (0.5 watt per h. c-p.)	1.28	640
Standard 6.6 amp. d-c. magnetite arc	1.5	750
Special 6.6 amp. d-c. magnetite arc	1.7	850
White flame carbon arc, best	1.95	975
Quartz mercury lamp	2.0	1000
Yellow flame carbon arc, best	3.1	1550
A-c. titanium arc	3.6	1800

It is interesting to note that the 6.6 amp. a-c. series enclosed carbon arc lamp, which has done practically all street lighting of America for many years, and has done it fairly satisfactorily, and which is still to-day the most widely used street illuminant throughout the country, does not even reach 200 c-p., but, as seen from Table II., gives only 175 available msph. c-p. About 400 c-p., or more than twice as much, is the lowest c-p. at which the gas-filled mazda lamp can be efficiently built (300 watts), while the 300 watt 4 amp. magnetite arc, which has been most successful in replacing the carbon arc in street lighting, gives an available 300 c-p., and the lowest titanium arc unit, of 220 watts, gives about 400 c-p. From this, it seems that the smallest units at which these high efficiency illuminants can be built are the industrially most important ones in street illumination, and even these are rather larger candle-powers than necessary for general street illumination in towns and cities. There is a general desire for more light, but more still is the desire for cheaper lighting, and there is a much greater appreciation of getting a reasonable increase of illumination—50 to 100 per cent.—at a reduced cost to the city, than there is of getting much more light at the same price; while even a very great increase of light, if accompanied by an increased cost, is rarely acceptable in street lighting, except in special cases of decorative lighting, of white way lighting, etc., and such special application naturally represents only a small part of the country's lighting. This is well illustrated by the experience of the arc lighting industry: when the arc lighting engineers became so interested in "large units" as to lose some interest in the low power high efficiency arcs and began to push the big luminous or flame arcs, the replacement of the 175 c-p. enclosed carbon arc by low power luminous arcs, which had been going on rapidly before, practically stopped, and the country turned to the mazda lamp, which offered lower power and therefore cheaper units.

Table V. Relative Efficiency of Various c.p. of Illuminants

(Watts per mean sph. c.p. in sizes indicated)

	200 c.p.	300 c.p.	400 c.p.	500 c.p.	1000 c.p.
A.c. carbon	490	620			
D.c carbon	380	480			
Mazda	310	470	620		
Standard magnetite		300	350	400	700
Special magnetite		(250)	290	350	550
Gas-filled mazda			310	390	730
Titanium			210	250	360
White flame				350	520
Yellow flame				280	406

Very interesting is the appearance, in the gas-filled mazda lamp, of the first incandescent lamp with an efficiency within the range of the modern arcs; as seen, more particularly in Table II., there is a considerable number of illuminants with efficiencies of one to one and a half candles per watt, which may be classed as "medium efficiency illuminants." The gas-filled mazda lamp falls in this group, between the different sizes and efficiencies of the magnetite arc; and cost of maintenance and replacement, quality or color of the light, etc., then become factors in the selection between these illuminants.

The group of illuminants below one candle per watt, comprising the various carbon arcs and vacuum incandescent lamps, is hardly of much further industrial value in street illumination, while on the other hand, in the yellow flame arc and in the titanium arc, efficiencies can be reached which no incandescent lamp can ever approach, and the latter illuminants, within their field of application, therefore still remain unrivaled in efficiency.

Tungstolier Company Absorbed

The business of the Tungstolier Company of Canada has been taken over by the Canadian General Electric Company, Limited. It is the intention to carry in stock a large assortment of electric fixtures for both commercial and residential lighting, and the C. G. E. Co., being equipped with an up-to-date fixture factory, will be able to give an excellent service. Communications regarding fixtures and glassware should be addressed to the Canadian General Electric Company, Limited, Fixture Section, Toronto, or to their nearest district office.

Owing to increasing demand for power, the Canadian Light and Power Company have decided on additions to the equipment at their plant at St. Timothee. The company have placed an order with the I. P. Morris Company, Philadelphia, for a 7,200 h.p. turbine operating under a head of 48 feet at a speed of 150 r.p.m. The turbine is of the horizontal shaft twin volute casing type, the contract including an I. P. Morris governor. A contract has also been closed with the Canadian General Electric Company for a 5,000 kv.a., 3-phase, 2,300 volt, 60-cycle, 150 r.p.m. generator. The Canadian Crocker Wheeler, Limited, will supply a 5,000 kv.a., three-phase, 2300/48000 volt, step up transformer.

The Dealer and Contractor

A Modern Theatre Switchboard

The illustration of the switchboard herewith shows one of two installations recently completed in Loew's new theatre, Yonge Street, Toronto. This photograph is of the board which controls the lights in the upper theatre. A corresponding board, though somewhat larger, controls the lower theatre. As will be noted, the board is divided into three panels. The left hand panel controls the lights on the stage, the middle panel the lights in the body of the theatre, the right hand panel the arc pockets, that is, receptacles to which portable arc lamps, used for various scenic purposes, can be connected.

The stage lights consist of three colors, red, white and blue, and these are controlled separately. Referring to the left hand panel of the switchboard it may be seen that the handles of the first six switches in the upper row are white. These control the white lights in six different groups. The seventh switch is a master which controls all the white stage lights. In the second row on this panel the switch handles are painted blue showing that they control the blue lights, in sections, on the stage; there is also a master switch controlling the blue lights altogether. The lower row of switches controls the red lights, with a master switch as before.

The centre panel controls the lights of the main body of the theatre. These lights are sectionalized by numerous switches but there is also one master switch by which all the lights may be turned on or off at once. The arc light switchboard controls the arc lights in section, and is also equipped with one master as before.

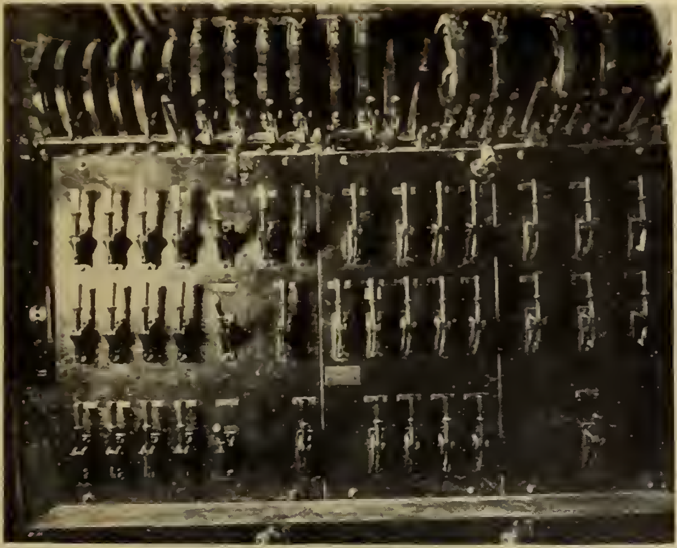


Fig. 1. Dimming and Control Switchboard.

Above the switchboard is shown the dimming machinery. The main body of the theatre can only be dimmed as a whole, and the control of these lights is shown by the first six sections (on the left) of the apparatus. Control is by one switch only and the resistances are so arranged that the variations in light intensities merge from one to the other without noticeable steps. The next seven sections control the white lights on the stage. These are sectionalized into six groups such as foot lights, borders, etc., each section controlled by its own dimming switch. All the white stage lights are also controlled by one master switch. This arrangement means that any one or more of the lights may be dimmed or all may be dimmed in unison. The third section of the dimmer controls the blue lights; there are four individual dimmers and one master dimmer. The fourth section represents the red dimmer; there are four individual dimmers and one master dimmer.

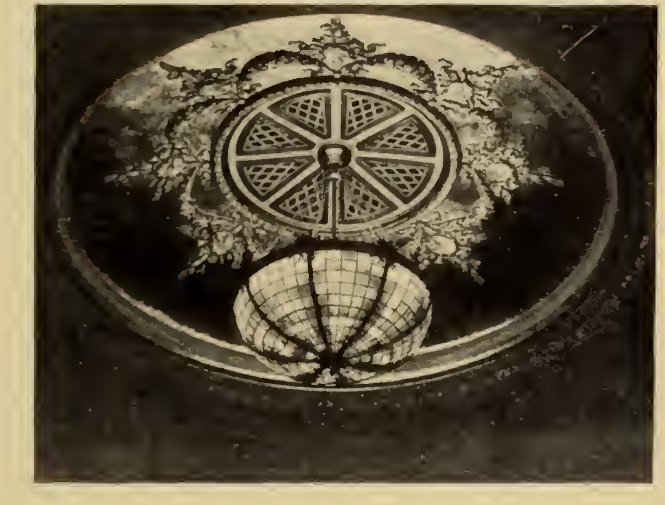


Fig. 2. Handsome semi-indirect unit.

The board is the latest type of dead face switchboard construction, all live parts being placed at the back. Below the board, not shown in the figure, there is a closed panel containing all the main fuses. This convenient location makes it possible for the operator of the switchboard to have control of the fuses without moving from his operating position.

At the back of the board is also a closed magazine panel made up in sections which correspond to the three sections of the main board, that is, one section controls the stage lights, one the house lights and one the arc pockets.

The main switchboard with all panels was supplied by the Metropolitan Electrical Manufacturing Company. A new feature of the panels is a slanting bottom which prevents the gathering of dust or anything else on the bottom of the panel board. We understand this design is being used throughout by this company. The dimming equipment is of the Cutler-Hammer type.

There is also an emergency lighting outfit entirely independent of the main switchboards and controlled from a small panel board in the box office. This supplies sufficient light in case of accident which might disable the stage switchboards. All the wiring throughout is in conduit.

The second illustration represents a large handsome indirect lighting fixture hanging from the ceiling of the lower theatre. This unit is approximately one foot in diameter and carries 120-40 watt lamps controlled by six circuits separately fused.

The electrical installation, which is one of the most complete of its kind in Canada, was made by the L. K. Comstock Company under the direct charge of Mr. W. R. Wadsworth. This same company are at present installing the electrical equipment in Shea's new hippodrome, Terauley Street, Toronto. They have also just commenced work on the electrical installation of the Abitibi Pulp & Paper Company, Iroquois Falls, Ont.

Outdoor High-Tension Sub-Stations

Among the developments of recent years none has been watched by the high voltage engineers with greater interest than the work being done along the line of outdoor weatherproof equipment. The demands of the engineering world for efficiency, service, and economy have been realized by its development and standardization.

The installation pictured, which is on the lines of The Georgia Railway & Power Company, is a modern example of the application of standard outdoor apparatus installed to meet a special requirement, and is deserving of an especial mention. The outdoor sub-station is located about two miles from the centre of Atlanta, Ga., along the South Decateur trolley line at the junction of the line to the Soldiers Home. The sub-station is used for stepping up a voltage of 11,000 used in and around Atlanta to 22,000 volts, at which voltage the sub-station supplies power to the Stone Mountain-Covington, Monroe transmission line, a total of about forty miles. This sub-station of 3000 kv.a. capacity is supplied from the 11,000-volt line from Atlanta, which received current from various sources, including the new Tallulah Falls power station ninety miles away, the Bull Sluice station fifteen miles away, several other water power stations, and two steam stations in the City of Atlanta.

The station has been in operation about six months, during which time absolutely no trouble has been experienced, although the nearest operator or attendant is two miles from the station. Fig. 1 shows the high tension bus work carried over the transformers, the 11,000-volt bus on the left hand side, and the 22,000-volt on the right.

Each of the three transformers weighs about 12 tons, and to handle them without difficulty a special "I" beam construction was used between the car body, on which they were transported, and the concrete platform, on which the transformers are now installed. The concrete platform is on a level with a car floor and the transformers were skidded along the greased surface of the "I" beams to their proper places.

The two steel structures, each of which carries a three-pole Burke high voltage air-break switch, lightning arrester, choke coil, and fuse, are of one of the several standard models of outdoor sub-stations built by the Transmission Engineering Company of Pittsburgh, Pa. The transformers rest on steel rails, partly imbedded in the concrete platform and extending its entire length. This facilitates sliding them under the steel towers, which are provided with a U-bolt, from which tackle can be suspended to lift the coils out of the tanks in case repairs or inspection should prove necessary.

This sub-station, demonstrating the practicability of outdoor transformer installations, was manufactured by the Railway & Industrial Engineering Company.

Mr. George E. Etlinger, of the firm of Jno. Birch & Company, Limited, export merchants and engineers, of London, Eng., is at present on tour in the Dominion. A number of English manufacturers have placed their interests in Mr. Etlinger's hands and he is open to appoint agents for the well-known switch gear specialties manufactured by George Ellison, of Birmingham. Communications may be addressed care of the Canadian Express Company, Montreal.

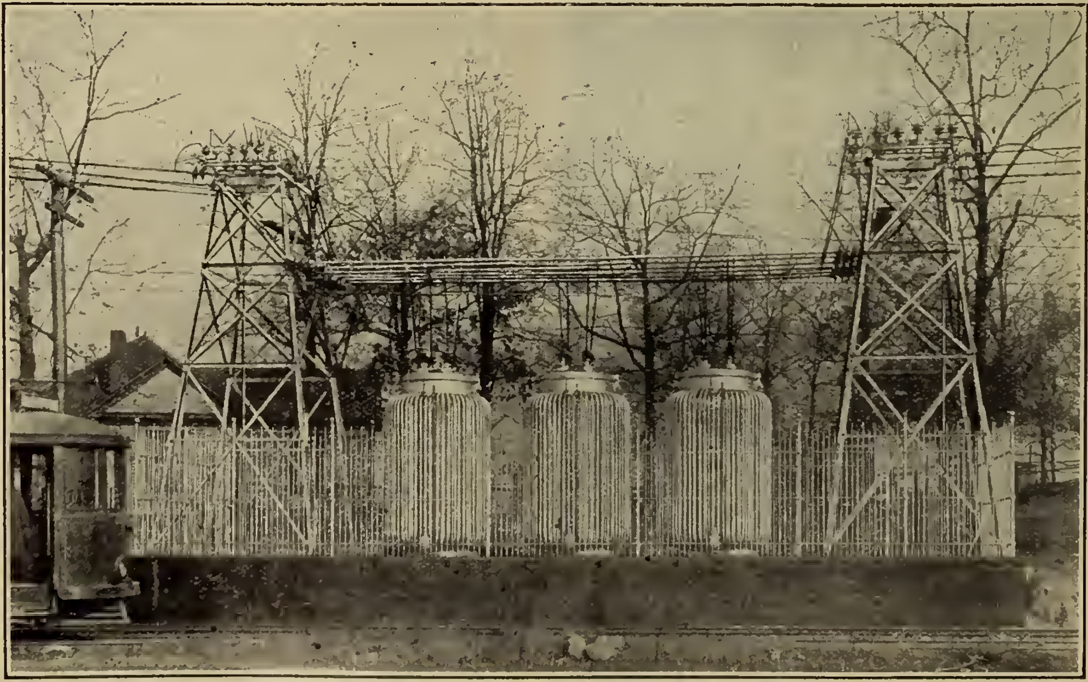


Fig. 1.—3,000 kv. a., outdoor, 11,000 / 22,000 volt, step-up transforming station.

New C. P. R. Montreal Station

The lighting installation recently completed in the new Windsor Station of the Canadian Pacific Railway Company at Montreal represents, at the same time, one of the most modern equipments both in control and in illuminating results that has been installed in Canada up to the present time. A brief description with interesting diagrams showing the layout of the wiring and lighting are given herewith and will prove of special value to the electrical contractor and illuminating engineer.

The new station measures, over all, including the main concourse, approximately 1100 ft. x 350 ft. The main panel which controls the whole of the lighting equipment is placed in the station master's office at one end of the concourse. From this point the different circuits pass out, three to the concourse and seven to the main section of the station where the trains are loaded. The station proper consists of eleven railway tracks, two between each row of supporting pillars. Each pair of tracks is separated by a passenger aisle.

The general distribution of the lights is shown in Fig. 1. The main panel board is seen at the lower end of the main concourse. The illumination scheme includes day lights, night lights, arc lights and bracket lights as shown in this figure. The day and night lights are 100-watt tungsten lamps enclosed in a steel enamelel (inside and out) Benjamin reflector fitted to a type "C" Crouse-Hinds condulet. The so-called arc lights consist each of a group of six 100-watt tungsten lamps.

Fig. 2 shows the general plan of the panel board for lighting the station. In the upper figure, which represents the train shed mains, current is supplied through two 500,000 c.m. cables and one No. 0000 cable all enclosed in one three-inch conduit. The concourse mains consist of two 300,000 c.m. cables and one No. 0000 cable contained in a two and one-half inch conduit.

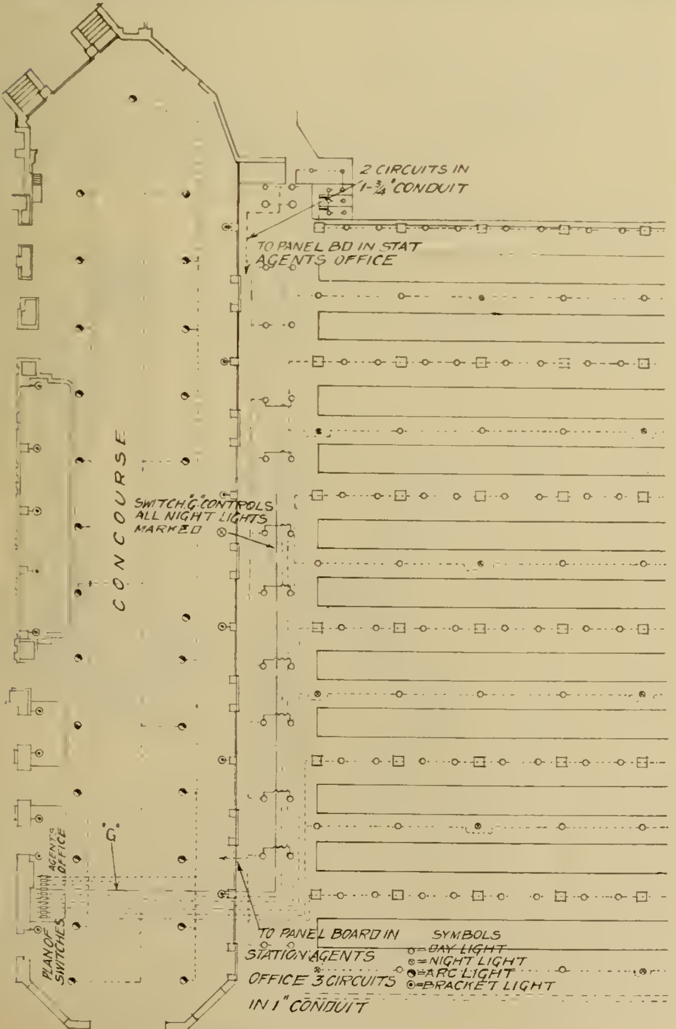

2 CIRCUITS IN 1-¾" CONDUIT
TO PANEL BD IN STAT AGENTS OFFICE
CONCOURSE
SWITCH.G CONTROLS ALL NIGHT LIGHTS MARKED ⊗
G
AGENTS OFFICE
PLAN OF SWITCHES
TO PANEL BOARD IN STATION AGENTS OFFICE 3 CIRCUITS IN 1" CONDUIT
SYMBOLS
○=DAY LIGHT
⊗=NIGHT LIGHT
●=ARC LIGHT
⊙=BRACKET LIGHT

Fig. 1. Section of Windsor station lighting system.

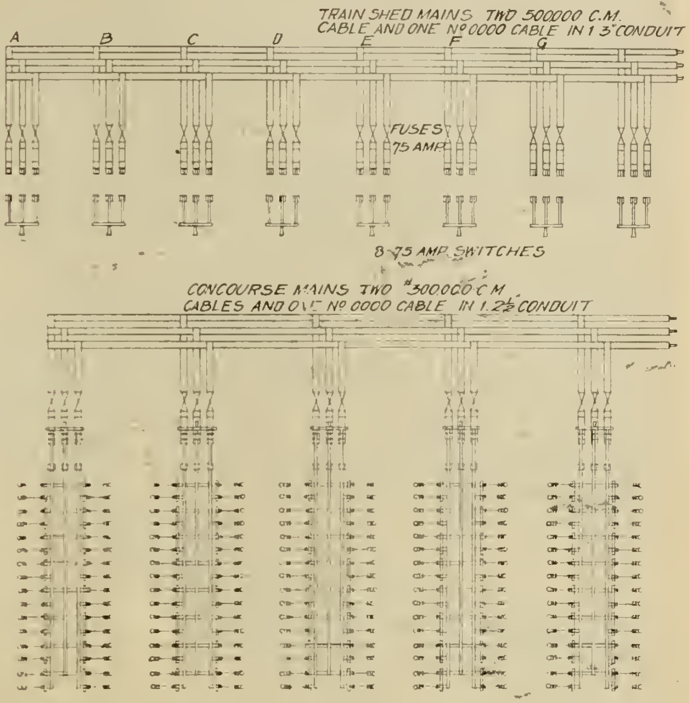

TRAIN SHED MAINS TWO 500000 C.M. CABLE AND ONE Nº 0000 CABLE IN 1 3" CONDUIT
A
B
C
D
E
F
G
FUSES 75 AMP.
8-75 AMP. SWITCHES
CONCOURSE MAINS TWO #300000 C.M. CABLES AND ONE Nº 0000 CABLE IN 1 2½" CONDUIT

Fig. 2. Plan of control panel board.

Fig. 5 represents the wiring diagram of one of the three 3-wire panel boards used for fusing the individual lamp groups. These three boards are placed along the length of the train section of the station at approximately equal intervals. The location of one of them and the method of wiring to the returns is shown in Fig. 3, which is a section of the station similar to that shown in Fig. 1, only with the concourse omitted and showing a little more of the body of the station.

The wire is all run in conduit and all outlets, not ending in junction boxes, have condulets. The conduit is fastened to the steel work of the building by standard galvanized pipe clips.

The distance from the platform to the base of the lamp

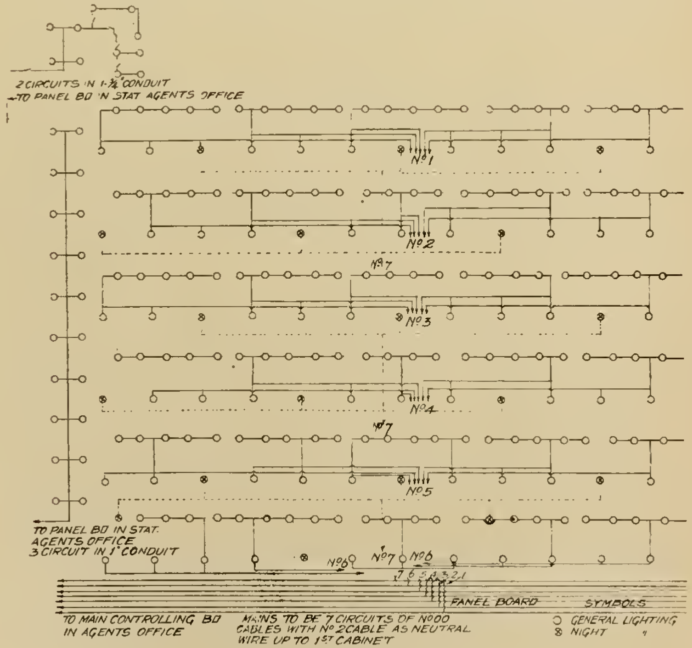

2 CIRCUITS IN 1-¾" CONDUIT
TO PANEL BD IN STAT AGENTS OFFICE
Nº 1
Nº 2
Nº 7
Nº 3
Nº 4
Nº 7
Nº 5
TO PANEL BD IN STAT. AGENTS OFFICE 3 CIRCUIT IN 1" CONDUIT
Nº 6
Nº 7
Nº 6
7 6 5 4 3 2 1
PANEL BOARD
SYMBOLS
○ GENERAL LIGHTING
⊗ NIGHT "
TO MAIN CONTROLLING BD IN AGENTS OFFICE
MAINS TO BE 7 CIRCUITS OF Nº 00 CABLES WITH Nº 2 CABLE AS NEUTRAL WIRE UP TO 1ST CABINET

Fig. 3. Section of station showing one fuse panel.

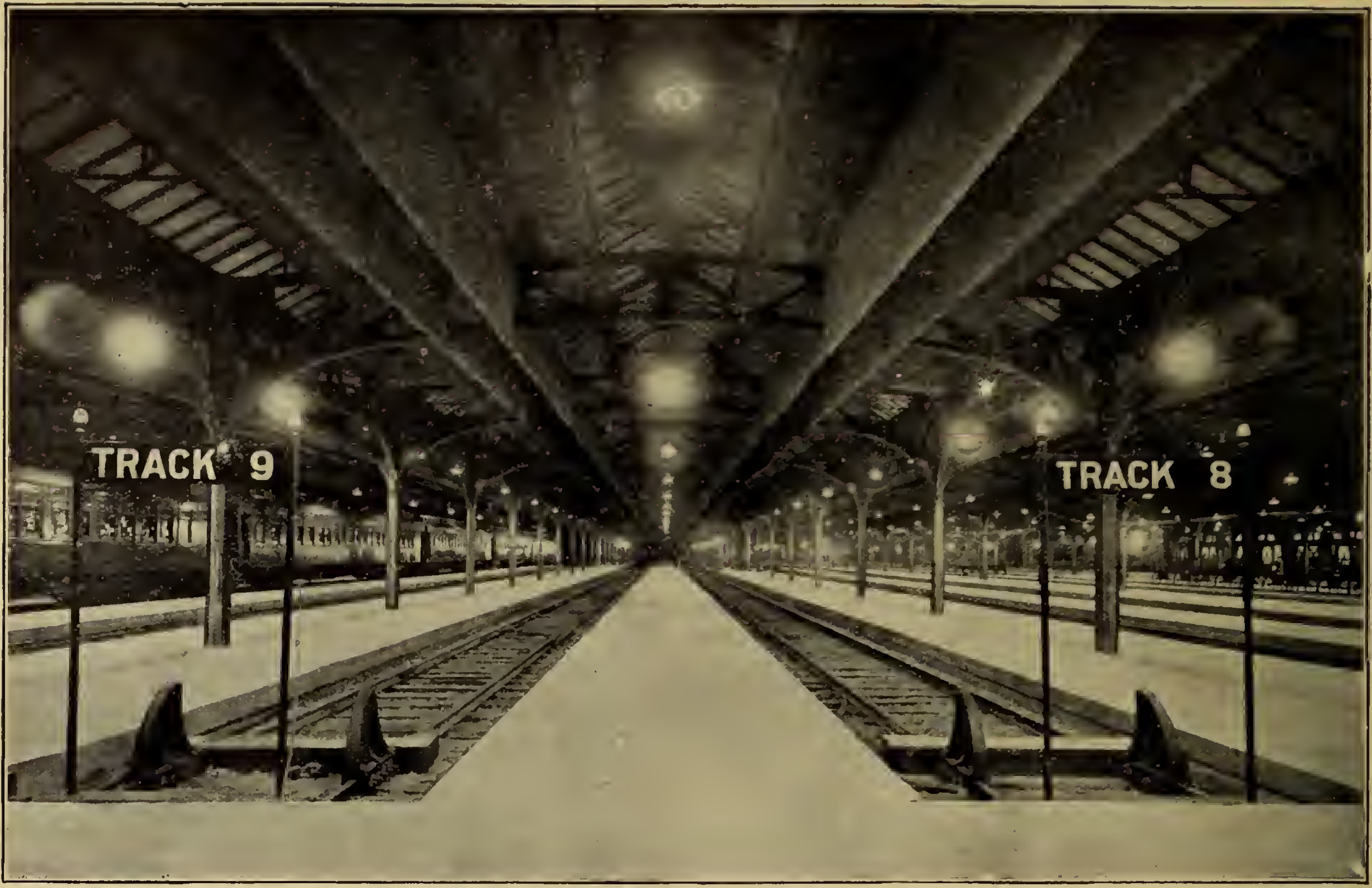


Fig. 4. General illumination view in the new C. P. R. Windsor Street station.

is fifteen feet and the lamps are spaced in alternate rows approximately twenty-eight and fourteen feet apart respectively, the rows being separated by a space of about twenty-two feet.

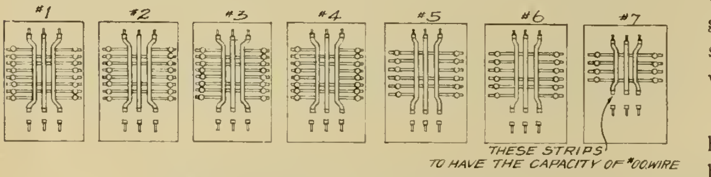


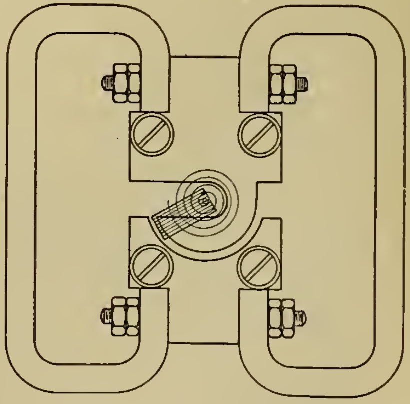
Fig. 5. One of three fuse panel boards.

Improved Laboratory Portable Meter

There has been a logical demand for a line of laboratory standard instruments, approaching in accuracy the meters of the precision type, suitable particularly for direct-current measurements, and therefore operating on the D'Arsonval principle. The ultimate limitation of such instruments, so far as permanence is concerned, is stability of magnetization of the permanent magnet. The old type of bi-polar or double-air-gap D'Arsonval construction, while sufficiently reliable for ordinary use, is considered somewhat questionable for use in instruments whose accuracy and permanence could be rated as high as that of precision instruments.

This limitation is overcome in the improved direct-current line of meters known as the "Type PL Laboratory Portable Meters" manufactured by the Westinghouse Electric & Manufacturing Company. They are made on the same design as the standard type PL portable meters which are adapted to general testing work, except that their extra long scale and strong magnets make them especially adapted for use as a semi-portable laboratory meter. They operate on the D'Arsonval principle, a moving coil and permanent magnet, which renders them free from all residual errors. The PL type meter differs, however, from other meters using the D'Arsonval principle in having a single air gap through which the moving coil, pivoted at one edge, swings. The single gap permits of maximum torque per unit weight for the following reasons:—

(1) The magnet will retain a higher permanent strength because the total air gap is relatively narrow and need never be disturbed. The complete movement can be taken out for inspection or repairs without removing any part of the magnetic circuit. Magnets in which the coil surrounds a cylindrical core forming part of the magnetic circuit, as in the usual double-gap movements, are subject to change in field strength if the coil is removed, because the cylindrical core has to be removed in order to remove the coil.



Plan of new portable meter.

(2) The strength of the magnet can be higher in the single-gap than in the double-gap movement for the mag-

nets of the latter can be only as strong as they would be when the core is out; otherwise they would lose a large part of their strength the first time the core and coil were removed.

(3) Since the coil when pivoted at one side counterbalances to some extent the weight of the pointer and thus reduces the counter-weight necessary when the coil is pivoted in the middle, as with the double-gap movement, the single-gap movement allows of a minimum total weight of movement.

(4) The strong magnets produce a high torque, which, with the light weight of the moving element, gives a high ratio of torque to weight, thus reducing friction errors to a minimum.

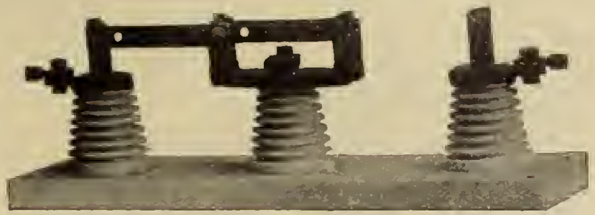
The accuracy of these meters is further assured by treating, magnetizing, and artifically ageing the magnets with their pole pieces complete according to the process originally developed by Madame Curie, the well known discoverer of radium, this process being recognized as incomparably superior to all other processes. To further guarantee against change in strength, the magnets after treating are stored for six months. Any magnets that show a decrease in strength after this time are rejected. The moving coil and pointer are then assembled in the magnetic structure and the manufacture is completed without disturbing the magnetic circuit, an arrangement impossible in the bi-polar D'Arsonval instruments. The light metal frame on which the moving coil is wound moves through the air-gap of the magnets and makes the reading inherently dead-beat. This important feature enables readings to be taken quickly and prevents violent fluctuations from injuring the pointer or the moving element. The scale, which is 11½ inches long, subtends an arc of 100 degrees, giving large open divisions which are of uniform length throughout. The scale has diagonal markings which facilitate accurate readings of fractions of divisions. A mirror extending the entire length of the scale enables the prevention of parallax in reading.

Electric Vacuum Cleaners

Among the portable type of electric vacuum cleaners the Eureka, manufactured by the Onward Manufacturing Company of Berlin, Ont., appears to be more than upholding its reputation as the most efficient and all-round reliable equipment that has yet been placed on the market. The 1914 model contains a number of valuable improvements. One of these consists in placing the wheels which uphold the nozzle just inside the nozzle instead of outside, making it possible to get much closer in to walls and corners. The handle is now allowed to move in a flexible way up and down without interfering with the angle at which the machine operates. The machine itself, in the new design, is held always in a fixed position on the floor by a third wheel placed under the motor. Other improvements consist in refinements of control and adjustment. In the illustration herewith the absence of the outside nozzle wheels can be noted as also the addition of the third wheel behind. It will also be seen that the adjustable handle enables the operator to work the machine with a maximum of ease. We understand that the Hydro-electric Power Commission of Ontario have adopted the Eureka as their standard and have recently placed orders for a considerable number.

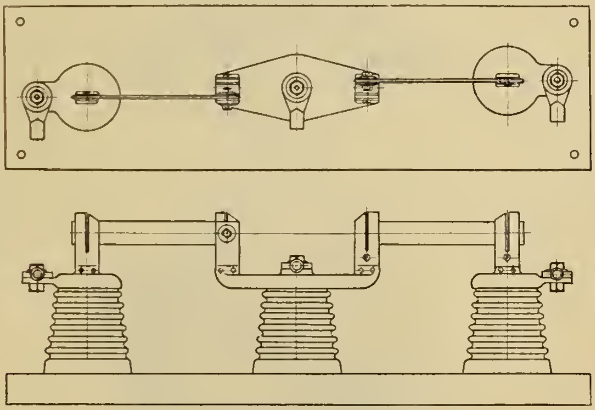
Selector-Type Disconnecting Switches

The selector-type of disconnecting switch is a transfer switch which does not require the circuit to be interrupted while making a change. It can also be used to connect two independent circuits in parallel. However, it is not designed for opening under load and therefore no attempt should be made to open it with current on the line. These switches are in effect two single-throw, single-pole disconnecting switches with the hinge jaws connected together and mounted on the same insulator. The hinge jaw is also provided with dummy jaws to hold either blade of the switch in the open position. Except for these differences in the hinge jaws, the construction of these switches is similar to the standard disconnecting switches of the same ratings.



Type O Selector type disconnecting switches with one side open.

Two types of these switches are made. One type is intended for wall mounting, the live parts being mounted on porcelain insulators carried on a cast iron yoke or base. This forms a simple, but substantial, construction that is neat in appearance and moderate in price; all parts of this switch, but the porcelain insulators, are finished in black marine. The other type is designed for indoor mounting on marble bases or switchboard panels. It is made for either front or rear connection of for any combination of front and rear connection desired. The copper parts are dipped and lacquered. These selector-type disconnecting switches are extensions of the regular line of disconnecting switches manufactured by the Westinghouse Electric and Manufacturing Company.



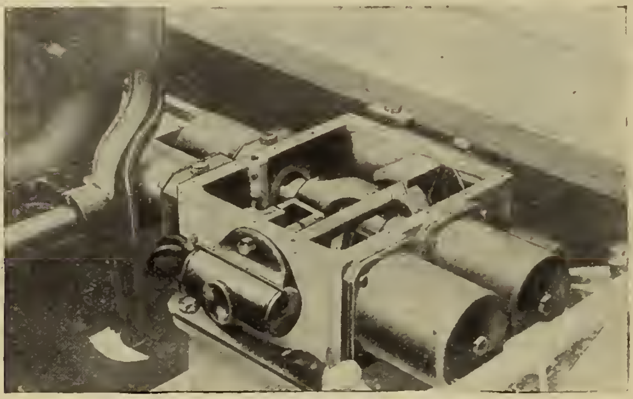
Detail of type O disconnecting switch.

Wheeler Condenser Equipment

Announcement is made elsewhere in this issue of the opening of a branch office in Montreal of the Wheeler Condenser & Engineering Company, Cartaret, N.J. This company was one of the first to concentrate its energies on the design and manufacture of steam condensing machinery and Wheeler condensers are now known the world over. With this equipment vacuums of from 28 to 29 inches are obtainable. Wheeler products include not only surface condensers but also high vacuum jet condensers, barometric condensers, centrifugal pumps, air pumps, feed water heaters, forced and natural draft cooling towers, etc. The Montreal office is in charge of Mr. Jos. McKay, Jr.

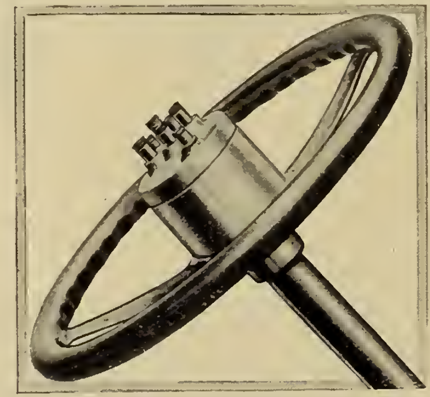
Electric Gear Shift for Gasoline Automobiles

The accompanying illustrations make clear the principle involved in the electric shifting of automobile gears, a system now used by a number of the manufacturers of high grade cars. Instead of employing a hand operated lever to shift the gears, power for this work is supplied by a solenoid capable of exercising a 150-pound pull. In the Vulcan system four such solenoids, mounted under the car, control respectively the high, low and intermediate forward speeds and the reverse speed. These solenoids are energized by battery current controlled from push buttons mounted on the hub of the steering wheel, the forward speed buttons being marked 1, 2 and 3 (for first, second and third speed) and the reverse speed button bearing the letter R. In addition there is a neutral button—N—which is used for stopping the car, and two auxiliary buttons (S and H) which enable the self starter and electric horn to be operated from the steering wheel.



Vulcan Electric Gear Shift for Gasoline Automobile.

When one of the speed changing buttons is depressed the circuit to the proper gear shifting solenoid is partly closed, but the actual closing of the circuit is not completed until the clutch pedal is thrown in, this carrying a small master switch which completes the circuit to the battery. Very little current is used as none is consumed except at the instant the gear shifting solenoid is energized. Actual tests have shown that the time of engagement of the master switch, and therefore the time that current is flowing from the battery, is less than one-third of a second for each gear shift.



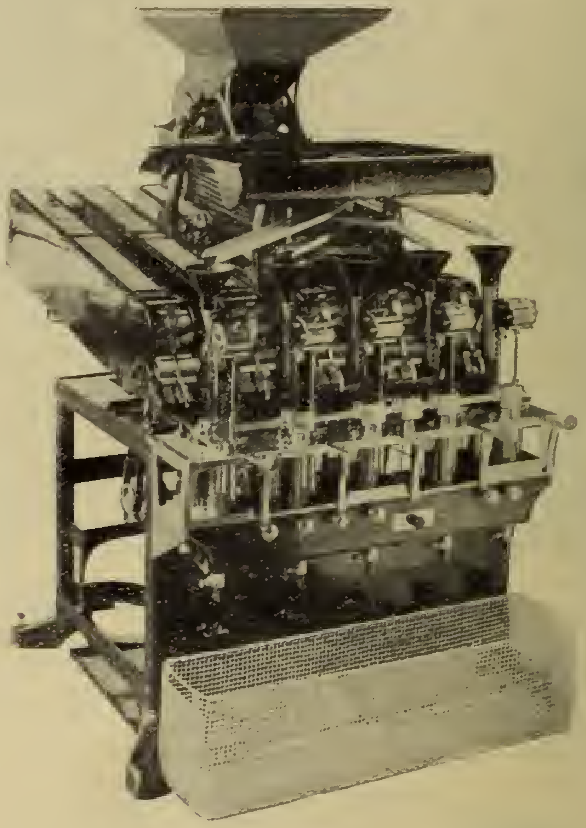
Showing push buttons mounted on steering wheel.

The Vulcan electric gear shift, formerly made by The Vulcan Motor Devices Company, Philadelphia, is now manufactured by the Cutler-Hammer Manufacturing Company, Milwaukee.

Considerable support is being given to the proposals of the St. John Hydro-electric Company, who propose to develop power and transmit to this city.

Motor-Driven Coin Handling Machine

Dump a miscellaneous lot of coins into the hopper of the machine shown in the illustration, start the Westinghouse electric small motor that drives it, and the machine will sort out the coins into denominations, count them in dollars and cents, wrap them up in standard packages, or sack them as you prefer, separate the mutilated coins and throw them into a separate receptacle. Evidently this machine should become popular among companies that have to handle small coins in large quantities such as street railway companies, gas and electric companies, department stores, tax receiving offices, water companies, banks, moving picture theatres, etc. It cuts down the time required to handle money and reduces the cost considerably. It also eliminates errors in counting and prevents pilfering. The machine is made by the Sattley Coin Handling Machine Company, Detroit, Mich.

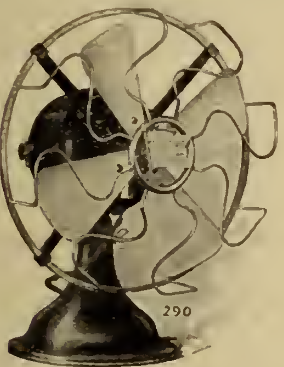


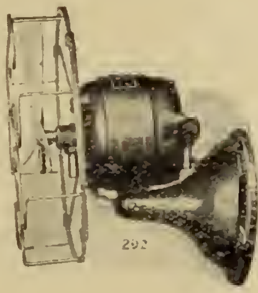
No Demerits

The Underwriters Laboratories Inc., Chicago, publish every three months a report which covers the products of the fourteen companies manufacturing metal conduit of different sorts in Canada and the United States. This corporation makes very careful daily tests of the products of each one of these companies and the daily records are carefully tabulated, arranged comparatively, and every three months distributed to the companies concerned. In the last report to hand, which covers the three months ending February 28, 1914, the Orpen Conduit Manufacturing Company of Toronto are to be congratulated on having no demerit marks on either their galvanized or enameled products. Indeed, for the last six months there have been no flaws whatever found in their enameled ware, so that they rank highest of all Canadian and United States factories. This is an exceedingly gratifying report for so young a company, which can only be interpreted as indicating that the methods of manufacture adopted by this company and the careful scrutiny exercised at every stage of the work, are of the best. The two principal products of this company to which they have given the names "Xceladuct" and "Orpenite," representing respectively their galvanized and enameled products, are already well known throughout the Dominion.

A New Eight-Inch Desk Fan

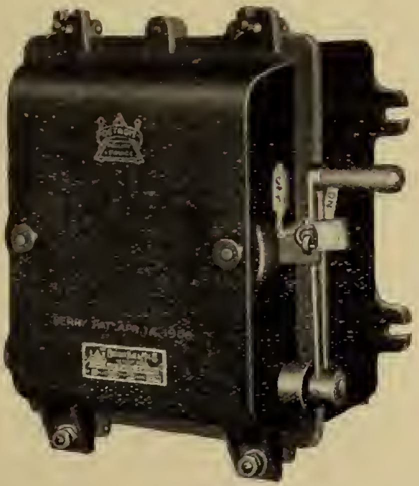
The illustrations herewith show the new 8-inch direct current desk and bracket fan developed by the Robbins & Myers Company, Springfield, Ohio, for the season 1914. This fan is made for both 110 and 220 volts, direct current circuits. By means of a speed regulating coil and switch in the base, three speeds can be obtained, 1,700, 1,400 and 1,000 revolutions per minute. At these speeds the respective wattages are 25, 20 and 15. A hinge joint provides for trunnion adjustment, adapting the fan for either desk or bracket service. The blades are made of the best grade sheet brass, and are riveted to a punched sheet carrier which is formed to give a uniform pitch to all blades—the pitch being such as to give maximum air displacement with minimum power. A strong durable guard surrounds the blades; it is fastened to the body by four steel supports which are fastened rigidly by screws. This guard is amply strong to permit the fan to be carried about by it without injury. The frame and base of the motor are highly finished in baked black enamel with fine gilt stripes; the blades are brushed brass finish and lacquered. In all details the fan is built strongly; it runs quietly and meets the needs of the home or office where larger fans are not desired.





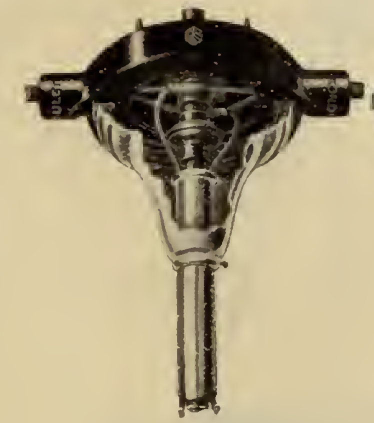
Awarded a Medal

The Detroit Fuse & Manufacturing Company were recently awarded a silver medal, on their iron-clad fuse switches, by the First International Exposition of Safety and Sanitation, held in New York. This was a recognition of the safety and accident prevention qualities of these switches. The cut herewith represents one of the types for which the medal was awarded.

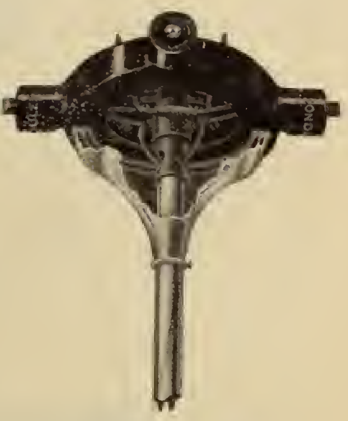


New Condulets

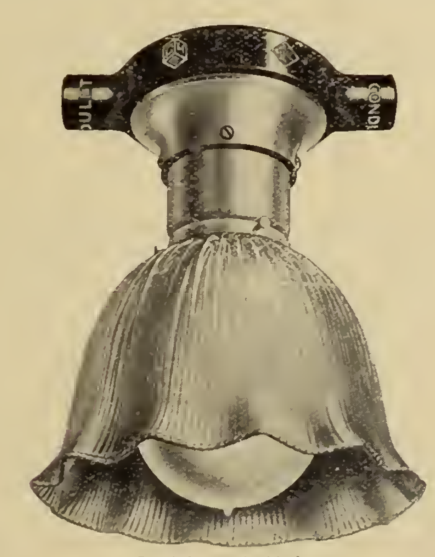
The illustration herewith represents type PM series of condulets for electroliers and combination gas and electric fixtures. This series is designed for use in exposed conduit systems and takes standard canopies and standard canopy installing rings from three to four inches in diameter. These condulets are so shallow that they are hardly noticeable when the canopies are fastened in place. A grounding clamp to ground the condulet on the gas pipe, above the insulating joint, is required with a combination gas and electric fixture. These condulets are being placed on the market by the Crouse-Hinds Company of Canada.



Arranged for combination gas and Electric Fixture.



Arranged for Electrolier – broken away view



Condulet with Abolite.

The Canadian Pacific Railway Company will extend their Alberta telephone system by some 410 miles of line this year. The work projected includes 27 miles out of Retlaw on the Suffield extension; 77 miles on the Lacombe branch; 25 miles out from Coronation; 150 miles from Bassano to Swift Current; 67 miles from Fort Steel to Golden. A quantity of this extension work is for connecting isolated systems already in operation.

The Great Western Railway Company of England have recently placed a contract with Herbert Morris, Limited, for the supply of all the chain-blocks which may be required on their system during the year 1914. This is the thirteenth successive year in which the Great Western Railway Company has decided to purchase Morris chain-blocks.

Indirect Unit for Summer

The cut herewith represents a type of indirect unit suggestive of summer weather. The bowl is contained in a wicker-work basket which gives a summer home or porch a very attractive and artistic touch. This type of unit is being sold by the National X-Ray Reflector Company.

The Esterline Company, Indianapolis, manufacturers of curve drawing instruments, announce that they have added the General Supplies, Limited, 122, 11th Ave. West, Calgary, Alta., to their branch agencies.

New Books

Elementary Magnetism and Electricity—By Cyril M. Jansky, B.S., B.A., Associate Professor of Electrical Engineering in the University of Wisconsin; McGraw-Hill Book Company, New York, publishers. Price $1.50 net. This is in effect a text-book and the author has had in mind the needs of students who may have had some practical experience with electrical apparatus or machinery but whose knowledge of the principles of its operation and of mathematics is limited. It is intended for individual or home study although it may be used in class work to advantage. The apparatus required to perform the experiments is inexpensive, however, and it is believed that most of it can be made by the student himself. The book contains 206 pages, well illustrated and printed, and bound in the standard binding of this publishing house.

Electric Car Maintenance—By Walter Jackson, McGraw-Hill Book Company, Inc., 239 West 39th Street, New York, publishers. Price $3.00. This book is a selection of articles from the columns of the Electric Railway Journal with a few added diagrams to make the volume more illustrative. To those who are in charge of the maintenance of electric railway cars this book should be especially interesting and valuable. As a rule the methods described are such as require no costly apparatus and of a kind which may be applied to a great many situations.

New Companies

The J. Z. Lajoie Company, Limited, has been incorporated with head office Lajoie Falls, B.C., and capital $2,000,000. The company is given wide rights, including the generation and transmission of electric power.

The Erie & Ontario Railway Company are seeking a charter to operate by steam or electricity from Port Maitland to Port Colborne passing through the townships of Sherbrooke, Moullin, Wainfleet, Gainsborough and Grimsby. The company also ask authority to develop and distribute electrical power.

The Norfolk & Elgin Railway Company are applying to the Dominion government for incorporation.

La Rigaud Electric and Milling Company has been incorporated with a capital of $159,000 and head office Rigaud, Que.

Trade Publications

Hospital Signal Systems—Circular No. 15003 issued by the Holtzer-Cabot Electric Company, Brookline, Mass., describing the most modern hospital signal equipment manufactured by this company.

C. G. E. Publications—Illustrated booklet B3290 dealing with Edison mazda automobile lamps; B3289 on C-G-E electric fans for a.c. and d.c. circuits; booklet 881R4 containing a sketch of the development of the iron-clad oxide battery.

Wiring Devices—Section B of the electric supply catalogue issued by Factory Products, Limited, Toronto; illustrated profusely and describing, with prices, a number of the different lines of electric wiring supplies and devices carried by this company.

High Tension Switch Gear—The Delta-Star Electric Company, Chicago, are distributing a new Bulletin No. 3 devoted to high tension line and outdoor sub-station equipment. 105 illustrations are shown, many of which are working installations. This treatise will be of interest to those engaged in high tension transmission.

Portable Instruments.—Bulletin 104 issued by the Wagner Electric Manufacturing Company of St. Louis. This is a manual on electric testing and testing instruments illustrated throughout with splendid line drawings. It is in fact a brief text-book on electrical testing.

G. R. S. Publications—Improved lightning arresters Model 1-B, described and illustrated in bulletin 106A; Model 2-A Signals, described and illustrated in bulletin 115C and in booklet 2019; EZ motion plate rail clips and R.S.A. detector bars, described and illustrated in bulletin 130.

Progress Report.—On the reference by the United States and Canada in the levels of the Lake of the Woods and its tributary waters and their future regulation and control, including public hearings at International Falls and Warroad, Minn., and Kenora, Ont., dated January 16, 1914.

Charging Three Cells—A folder issued by the Westinghouse Electric & Manufacturing Company describing a good method of charging three cells, the number usually used for ignition and lighting in automobile work. The booklet describes the Westinghouse type G vibrating rectifier used for this purpose.

New Glassware.—A handsome catalogue has just been issued by the Jefferson Glass Company, Toronto, illustrating and describing in detail the newest ideas in these Canadian made products. Some of the reproductions are in color showing how the fixtures may be made to blend with the general decoration of a room. This catalogue is one of the most artistic publications of the year.

Burlington Steel Company, Limited

Owing to the similarity of the names of a number of companies operating in Hamilton and the confusion arising therefrom, the directors of the Canada Steel Company have decided to change the name of their company to the Burlington Steel Company, Limited. Business will be transacted in future under the new name.

Current News and Notes

Brantford, Ont.

The ratepayers of Brantford by a vote of 1317 to 83 have decided in favor of purchasing the local railway system and operating it is a municipal enterprise.

Calgary, Alta.

The firm of Kerry & Chace, consulting engineers, Toronto and Winnipeg, have received instructions from one of their clients to make a report on the possibilities of the Grand Rapids Falls on the Athabasca River. At this point there is said to be a possible head of 55 feet.

Edmonton, Alta.

The city council have called for tenders for cedar poles, tungsten lamp brackets and miscellaneous electrical material; also a quantity of wire and cable.

Gowganda, Ont.

Messrs. Chas. Barber & Sons, Meaford, Ont., have just completed the installation of an 800 h.p. hydro-electric power plant for the Miller Lake-O'Brien Mine, Gowganda, Ont.

Halifax, N.S.

A special turbine to supply light for the chocolate factory of Moirs, Limited, Halifax, is being supplied by Messrs. Chas. Barber & Sons, Meaford, Ont. This is a repeat order.

Hamilton, Ont.

The estimated cost of street lighting for 1914 is $88,125.

Hantsport, N.S.

A contract has been closed with the Canadian General Electric Company for the supply of electric equipment in connection with a small generating plant being installed as follows:—one 62½ kv.a., 1200 r.p.m., 2200 volt, belted generator; one 3 kw., 125 volt, belted exciter; one combination generator and exciter panel; lighting material, etc.

Kalso, B.C.

The electric plant of the Kootenay Electric Company will be taken over by the municipality as a result of the overwhelming vote of March 4. The purchase price is $27,500. This also includes certain undeveloped water power rights held by the company.

Khedive, Sask.

The Khedive Rural Telephone Company have called tenders for the installation of 35 miles of rural telephone line.

Kingston, Ont.

The Hydro-electric Power Commission of Ontario will be asked to give a report to the Civic Utilities Commission of Kingston on the power possibilities of a high falls on the Madawaska River, some ninety miles out from Kingston.

Kisbey, Sask.

Tenders are called by the Crocus Bell Rural Telephone Company for the equipment required in the construction of their system.

Montreal, Que.

As soon as the frost is out of the ground, the Montreal and Southern Counties Railway Company will commence the construction of an extension from St. Cesaire to Granby, a distance of 15 miles.

The Ferranti Electric Company have received an order from the Canada Cement Company for one 250 kw. La Cour motor-converter; also an order from Messrs. Armstrong, Whitworth & Company for two 350 kw. sets to be used in their new Canadian works in Montreal.

At the annual meeting of the Calgary Power Company, held in Montreal, one new director, Mr. C. C. Giles, was elected, and four former directors, Messrs. H. S. Holt, A. R. Doble, W. H. Hogg, and R. T. D. Aitken, retired. The board as elected is made up as follows:—R. B. Bennett, M.P., president; Sir W. M. Aitken, M.P., F. P. Jones, E. R. Wood, A. E. Cross, H. A. Lovett, C. C. Giles, with V. M. Drury, secretary.

After holding four meetings, a special civic committee of Montreal appointed to study the tramway report of Mr. G. R. MacLeod, railway engineer of the council, have adjourned "sine die." This report recommended the construction of subways and the improvement of the tramways service, and although the committee held four meetings practically no progress was made. In view of the aldermanic elections, it was felt that the question should be considered by a new committee, and that the interests involved were too important to be discussed by a dying committee.

The quantity of underground work installed by the Bell Telephone Company of Canada during the last 23 years, in five year periods is given by the following table:

Year	Miles Conduit	Miles Single Duct	Miles Cable	Miles Wire
1890	1.85	43.16	1.04	103.72
1895	12.10	143.64	16.35	2,211.54
1900	46.71	321.07	156.57	30,686.40
1905	99.62	572.56	264.34	94,131.80
1910	191.10	1,014.66	453.35	208,956.02
1913	258.00	1,577.00	710.28	335,735.00

At the annual meeting the board and officers were re-elected as follows:—C. F. Sise, president; Hon. Robert Mckay, vice-president; Theo. N. Vail, Robert Archer, Wm. R. Driver, Hugh Paton, Charles Cassils, H. B. Thayer, L. B. McFarlane, managing director; Z. A. Lash, K.C., U. N. Bethell, C. F. Sise, Jr., general manager.

Ottawa, Ont.

A delegation of over 2,000 persons—said to be the largest that ever appeared before the Dominion Government—met in Ottawa on March 26 to urge assistance for hydro-radials throughout Ontario. The necessity of improvement in the St. Lawrence waterways was also strongly urged.

Port McNicol, Ont.

The local branch of the Quebec Bank requires electric fixtures for the bank and attached residence.

Prince Albert, Sask.

The city council is considering the addition of a 750 kw. turbo-generator unit to their existing steam plant.

Tenders are called by the Provincial Department of Telephones for the erection of a telephone exchange to be built at a cost of $50,000.

A proposition to take over the La Colle Falls hydro-electric scheme and complete it, has been presented to the city council by N. W. Morton who represents the Anglo-Dutch Financial Corporation of London. The corporation asks a 40-year franchise for power and street railway operations.

Regina, Sask.

The provincial government have called tenders for the construction of a number of long distance telephone lines.

The operation returns of the city of Regina municipal street railway system for the week ending March 7 are as follows; revenue $4112.15; passengers carried 96,912. The corresponding figures for the week ending March 14 are $5,093.75 and 119,810.

Rimouski, Que.

A turbine to light the mill of Price Bros. and Company is being supplied by Messrs. Chas. Barber & Sons, Meaford, Ont.

Saskatoon, Sask.

Contracts for electrical equipment have been awarded as follows:—pole type transformers, fuse wire, etc., Canadian General Electric Company; wire, cable and poles, Western Electric Company; meters, Ferranti, Limited.

Sherbrooke, Que.

The Sherbrooke Railway, Light and Power Company have closed a contract for the supply of 3000 h.p. to the Canada Brake-Shoe Company, Drummondville.

St. Catharines, Ont.

On March 20th delegates from different points in the Niagara Peninsula met in St. Catharines and formed a hydro-radial union for that district. Various resolutions were unanimously adopted dealing with the improvement of the waterways route of the St. Lawrence and the early construction of hydro-radials throughout western Ontario.

St. John, N.B.

The St. John Railway Company have placed an order with the Tillsonburg Electric Car Company, Limited, of Tillsonburg, Ont., for twelve cars, 20 ft. body, Brill 21E trucks. These cars will be turtle-back roof, interior cherry finish with vestibules arranged for p.a.y.e.

St. Lambert, P.Q.

The town of St. Lambert, P.Q., propose to improve their lighting arrangements, the plans including the erection of 43 5-light standards, and the construction of 7050 feet of single conduit.

St. Thomas, Ont.

An offer has been made to the city council by a private citizen to take over and operate the municipal street railway system for a period of five years. The offer is said to be favored by a number of the aldermen as, under the present system, there is an annual deficit.

Streetsville, Ont.

A by-law will be submitted on March 31 authorizing the council to raise $6,000 for hydro-electric extensions, power to be supplied by the Ontario Hydro-electric Power Commission.

Toronto, Ont.

In the local house Mr. Thos. Marshall, M.L.A., has introduced the following resolution. As Mr. Marshall is a liberal in politics it is evident that the hydro railway question is receiving the hearty support of both parties.

"That in the opinion of this House cheap and convenient electric railway transportation facilities are one of the most urgent needs in many rural sections, and the towns of the Province, and this House is gratified to see the general movement among the municipalities of the Province to secure improved electric railway transportation facilities through the Hydro-electric Power Commission.

"That this House views with satisfaction the prompt manner in which this question has been taken up by the chairman of the Hydro-electric Power Commission, and would respectfully memoralize the Government of the Dominion of Canada to grant to Hydro-electric radial railways constructed by or for the benefit of the municipalities of the Province under the direction of the Hydro-electric Power Commission a subsidy in all respects equal to that granted to steam railways under the provisions of the Act governing the granting of subsidies to aid in the construction of railways."

A great improvement is noted in many of the more dangerous street crossings in Toronto as a result of special lights being placed over the centre of the intersection. Tungsten lamps aggregating from 500 to 1,000 candle power are being used in each case.

Senator Peckham has introduced a bill in the New York legislature creating a waterways commission which will investigate and make a report at the next session as to what legislation is feasible to best conserve the water powers of the State and provide for their utilization in the public interests.

In his more recent public utterances the Hon. Adam Beck has suggested government ownership of the many independent telephone companies throughout Ontario. It is pointed out that there is much unnecessary duplication both of management and equipment which can be avoided under government control.

Verdun, Que.

The Montreal Light, Heat and Power Company have closed a contract for supplying the city of Verdun with 500 h.p. of current.

Winnipeg, Man.

A contract has been awarded by the Board of Control to the Standard Underground Cable Company for a quantity of weatherproof copper wire.

Welland, Ont.

The Welland Electric Company have closed a contract with the Ontario Tire & Rubber Company for the supply of 100 h.p. of electric energy at $12 per h.p. year.

Woodbridge, Ont.

A by-law will be submitted on April 11 authorizing the council to raise $6,000 by debentures to install a distributing plant. Power will be obtained from the Weston station of the Hydro-electric Power Commission of Ontario.

Rubber Covered Wires and Cables

FOR POWER, LIGHT AND TELEPHONE WORK

Incandescent Lamp Cord, Flexible Switchboard Cables, Special Cords and Cables for all kinds of Electrical Work.

Prompt Shipments from Canadian Factory.

BOSTON INSULATED WIRE & CABLE COMPANY

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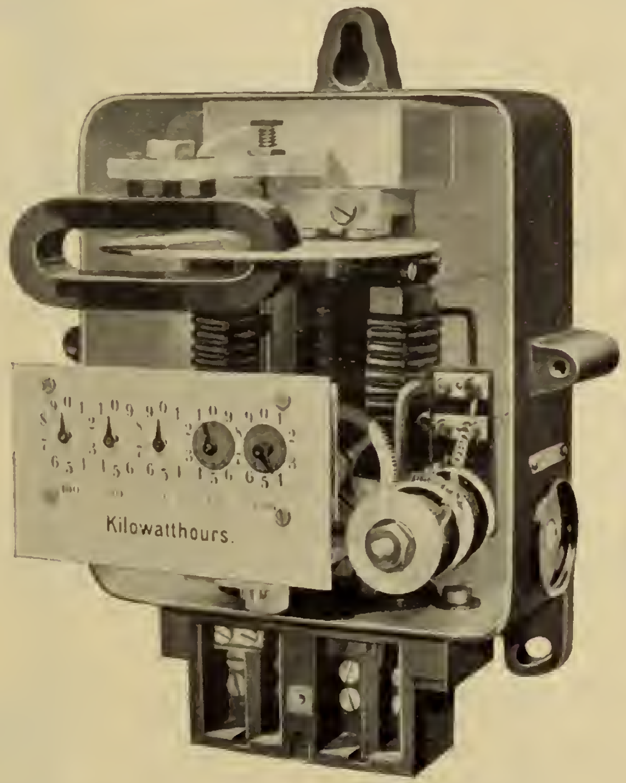
SIEMENS - SCHUCKERT | SIEMENS & HALSKE

Siemens Single Phase Meters

Type W. 3.



No locking screw. Spring-supported Bottom Bearing

Bottom pivot with jewel, and bearing with oil-well can be easily replaced on site without necessitating recalibration.

Keep in working order for years without attention

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Advertisements under "Situation Wanted" "Situation Vacant" or Miscellaneous, are charged at 2 cents a word per insertion, minimum charge 50 cents.

Advertisements for tenders, equipment, wanted or for sale, etc., are charged at $2.10 per inch.

All advertisements must be in the publisher's hands by the 10th or 23rd of the month to insure insertion in the subsequent issue.

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72 kw. alternator, 2-phase, 60 cycle, 1100 or 2200 volts. Regulator heads. Only run three years. 2½ kw. exciter. Marble switchboard with all instruments.

Auroro Electric Light Company,
Aurora, Ont.

March 23, 1914. 7

For Sale

Motor Generator Set consisting of 1¾ h.p. 230 volt, Roth d.c. Motor, directly connected to a 9 amp., 60 cycle, 110-220 volt Generator, complete with regulator, starter and full set of instruments, guaranteed first class in every particular. This set was made one year ago and has been used less than one hour a day for testing very small motors. Price $175.

Reynolds Electric Flasher Manufacturing Co.
7-8 422 So. Talman Ave., Chicago.

CITY OF PRINCE ALBERT

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1—13 x 24 x 30 Leonard Corliss Horizontal Compound condensing Engine. Nominal rating 150 h.p. at 95 revs. Flywheel 13 ft. x 26 in. face.
1—400 Sq. Feet Surface Condenser.
1—150 H.P. Closed Type Feed Water Heater.
1—Tubular Boiler. 60 in. x 14 ft.
1—Line Shafting, 24 ft. x 3 15/16 in. diameter, equipped with 4 adjustable floor stands, 2 Dodge patent friction clutches, 3 wood rim pulleys.
1—Belt tightener with pulley 24 in. diam. 26 in. face.

All the above is in good condition, having been used in the Electric Light and Power Plant and was superseded by larger units.

For further information apply,

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Tenders will be received by the city of Fernie, B.C., up to May 6th, 1914, for a complete tungsten street lighting system covering a circuit of nine miles and having 100 candle power lamps and 100 street brackets.

Equipment will include one 10 or 12 kw. tungsten regulator and one panel-board fitted with instruments and switches for control of above series street lighting.

JAMES E. FINN,
Supt. Light and Power.
Fernie, March 20, 1914. 7

Situations Wanted

ELECTRICIAN

Electrician open for engagement; experience in wiring, operating and repair work; eight years in present situation; best references. Apply Box 987, Electrical News, Toronto. 7

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Trained Mechanic

WANTED—Thoroughly trained mechanic to take charge of the hydraulic inspection and maintenance of a large Hydro-electric plant in the East. Should preferably have had similar experience in some other plant or in the installation of water wheels. State full particulars as to training and experience. Address Box 994, Electrical News, Toronto. 7-8

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Bought, sold, rented, and exchanged. We have the largest stock in America. Send for our monthly bargain sheet showing complete stock with our prices.

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Established 1893

Electrical Machinery

Motors, Dynamos, Generators,
Electrical Pumps and Supplies.
Electrical Contractors.
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PROCURED IN ALL COUNTRIES
LONG EXPERIENCE IN PATENT LITIGATION
SEND FOR HAND BOOK

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IF YOUR BUSINESS ISN'T WORTH ADVERTISING, ADVERTISE IT FOR SALE

We Have a Bell For Every Purpose

There can be only one best and that is the Schwarze. No. 12 Common Magneto Extension for telephone Service is illustrated herewith. The spools are large enough so that in no case is it necessary to use over No. 35 magnet wire, thereby obtaining the maximum number of ampere turns, and this wire is all active. Armature is under influence of coils its entire length. Poles arranged so that permanent magnet cannot be discharged, and will not weaken.

No. 13, same as No. 12, except larger and very much louder, and is for signalling purposes on high tension 60 cycle. Fully approved by Underwriters.

All weatherproof. Write for catalogue. All resistances.

Schwarze Electric Co., Adrian, Michigan
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A. C.

Ammeters and Voltmeters, Wattmeters, Synchroscopes, Power Factor Meters and Frequency Meters, constitute a line of Switchboard Alternating Current Indicating Instruments which is unequalled. Send for our Catalogs giving full description of these instruments. They are accurate—durable—dependable—and we stand back of them.

Demonstrations of the operative characteristics of these remarkable instruments may be observed in our New York office, and also in the offices of Selling Representatives in Philadelphia, Chicago, San Francisco and Toronto.

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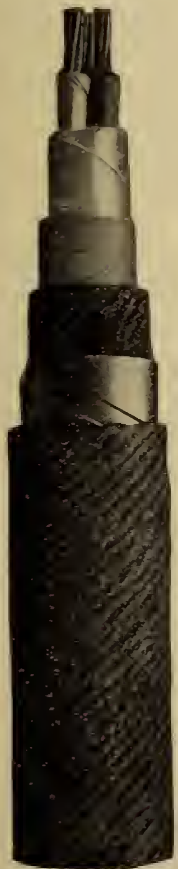
Chicago, 832 Monadnock Blk.
Boston, 176 Federal Street.
Philadelphia, 342 Mint Arcade.
Birmingham, American Trust Bldg.

Detroit, 618 Union Trust Bldg.
St. Louis, 915 Olive Street.
Denver, 231 15th Street.
San Francisco, 682 Mission St.
Cleveland, 1729 E. 12th Street.

Toronto, 76 Bay Street.

Winnipeg
Montreal
Calgary
Vancouver
Northern Electric Company, Limited

London, Audrey House, Ely Place, Holborn.
Paris, 12 Rue St. George
Berlin, Genest St.5, Schoenberg.
Johannesburg, So. Africa, F. Peabody Rice, Standard Bank Building, Harrison St.



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Manufactured by

British Insulated & Helsby Cables, Limited

PAID-UP CAPITAL, $8,500,000.00

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Illustration shows a No. 10 B & S, 3 conductor, paper insulated lead covered and double steel tape armored cable for a working pressure of 660 volts. This cable is for laying direct in the ground without any protection whatever and is similar to that supplied to the cities of Saskatoon, Prince Albert, etc., etc.

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SOLE CANADIAN REPRESENTATIVES:

Canadian British Insulated Co. LIMITED

MONTREAL, QUE.

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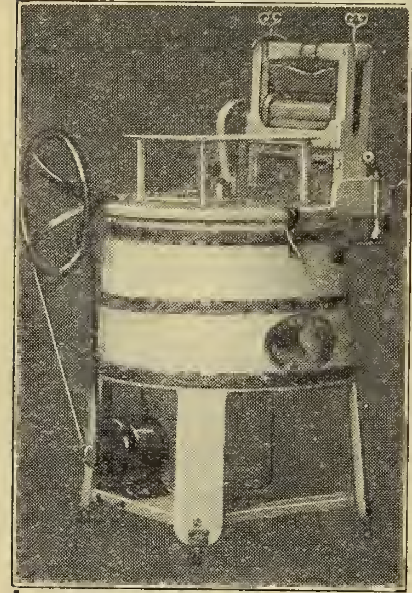
19 to 23 South Eleventh St., St. Louis, Missouri

Manufacturers of

Switchboards — Panelboards — Cabinets, Etc.

We are in position to make up your special requirements at a low cost—Write us for prices before placing your next order.



When you want a suit of clothes you go to your tailor don't you? —well then

isn't it reasonable to believe that when a housewife wants an electric washing machine she will go to the electric dealer for it. ***Of course she will.***

And every housewife who has electricity in her home will buy a good electric washer.

"White Dove" Electric Washer

is one that every housewife will be proud of. Let her see it once and she will not be content until she has one in her home.

Every White Dove Washer is guaranteed to give lasting satisfaction, each machine being rigidly tested before leaving our factory.

You can't go wrong on stocking the White Dove.

Get particulars of our special Central Station proposition.

THE WHITE DOVE WASHER CO., Cobourg, Ont.

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should be advertised for in the "Tenders and For Sale Department" of the CONTRACT RECORD AND ENGINEERING REVIEW. This paper is the "Tender Ad." medium of Canada and always brings bids from the reliable contractors and supply houses.

File your plans for any work on which you are inviting bids, in our offices at Toronto, Montreal, Winnipeg or Vancouver.

Contract Record
and Engineering Review
Toronto Ontario

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Quantity 25′ to 36′ peeled poles ready for immediate shipment.

F.O.B. cars G.T.R. Sherbrooke, Que.

The Fletcher Pulp & Lumber Co.
Limited
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Underground Conduits and Transmission Lines

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"EVERSHED'S" BRIDGE - MEGGER

Range .01 ohms to 1000 meg-ohms.

Indispensable as a fault finder.

Accurate in results, Simple to operate.

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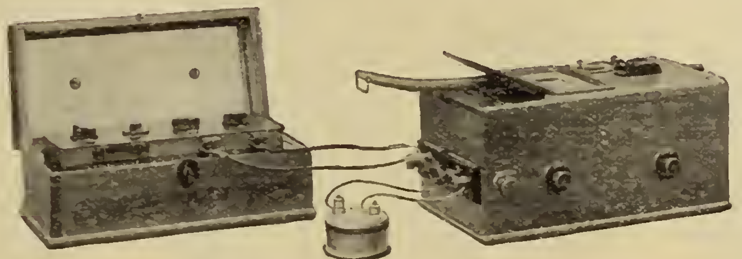

Testing by Bridge-megger method

Representatives at MONTREAL OTTAWA

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INSULATING MATERIALS

DELTATAPE is a heat resisting, insulating material having asbestos fibre as a base, and can be raised to a temperature of 500 degrees Fahr. before decomposition begins. It serves both as an insulator and a conductor of heat, and therefore unlike most asbestos coverings, while it thoroughly insulates a coil wrapped with it, it does not cause the coil to retain heat. These and the many other outstanding qualities of Deltatape make it especially adaptable for railway motor and controller work, where high temperature and severe conditions have to be met.

DELTA SHEETING is identical with Deltatape in properties, texture and finish, and is intended for use where large pieces of insulating material are required.

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Offer for sale the following

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2—50 H.P. Type C. Westinghouse, 2 phase, 60 cycle, 220 volts, 900 Rev. Starter, rails and pulley.
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1—20 H.P. Type CCL Westinghouse, 2 phase, 60 cycle, 220 volts, Starter, rails and pulley, 1200 Rev.
1— 5 H.P. Type CCL Westinghouse, 2 phase, 60 cycle, 220 volts, 1800 Rev.
1— 1 H.P. Type CCL Westinghouse, 2 phase, 60 cycle, 220 volts, 1800 Rev.
1— 3 H.P. Type KQ C.G.E. 2 phase, 60 cycle, 220 volts, 1800 Rev.
2— 2 H.P. Type 1G C.G.E., 2 phase, 60 cycle, 220 volts, 1800 Rev.
6— 1 H.P. Type S T.H.E., 2 phase, 60 cycle, 220 volts, 1800 Rev.
4— 2 H.P. Type S T.H.E., 2 phase, 60 cycle, 220 volts, 1800 Rev.
2—10 H.P. Type S T.H.E., 2 phase, 60 cycle, 220 volts, 1800 Rev.
3—½ H.P. Type S T.H.E., 1 phase, 60 cycle, 110 volt, 1200 Rev.
2—½ H.P. Type A T.H.E., 1 phase, 60 cycle, 110 volt, 1200 Rev.

For further particulars address

Toronto & Hamilton Electric Co.
HAMILTON, ONT.

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The Willard Storage Batteries.

REPAIRS — REWINDS — RE-DESIGN

Send in that broken down machine and have us give you a price to make it good, nothing too small and nothing too big. You know the old slogan "A stitch in time saves nine" it holds good with your plant, a new coil dropped in your machine at the right time saves rewinding it.

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The Electrical Engineering Co. of Toronto

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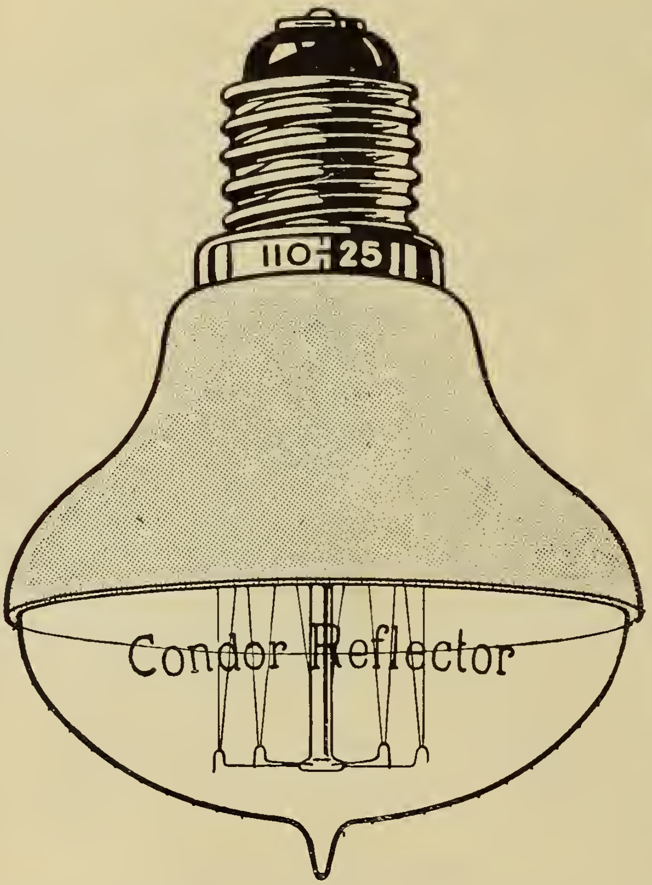
This is the New

"CONDOR"

Reflector Lamp

(Canadian Patents Applied for)



We are getting orders for this new lamp every day.

If you have not already sent in your order

DO SO AT ONCE

Remember—it is the only interchangeable Reflector Lamp on the Canadian market.

Sole Canadian Distributors

C. H. BASTERS & CO.

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Use the Railway's Trolley Poles

as the basis of your new street lighting system. You can easily convert them into attractive Mazda Lamp Standards or arc lamp supports by use of

ERECO Combination Railway Lighting Pole Fixtures

This system, besides saving you the expense of underground construction, gets the wires up out of the way of traffic, where they are practically unnoticeable and the curb line is not crowded with separate lighting standards.

The progressive railway management will gladly co-operate with you with this object in view.

Design No. 10015.

Electric Railway Equipment Co.

Cincinnati, Ohio

Designers Manufacturers

Canadian Representatives:

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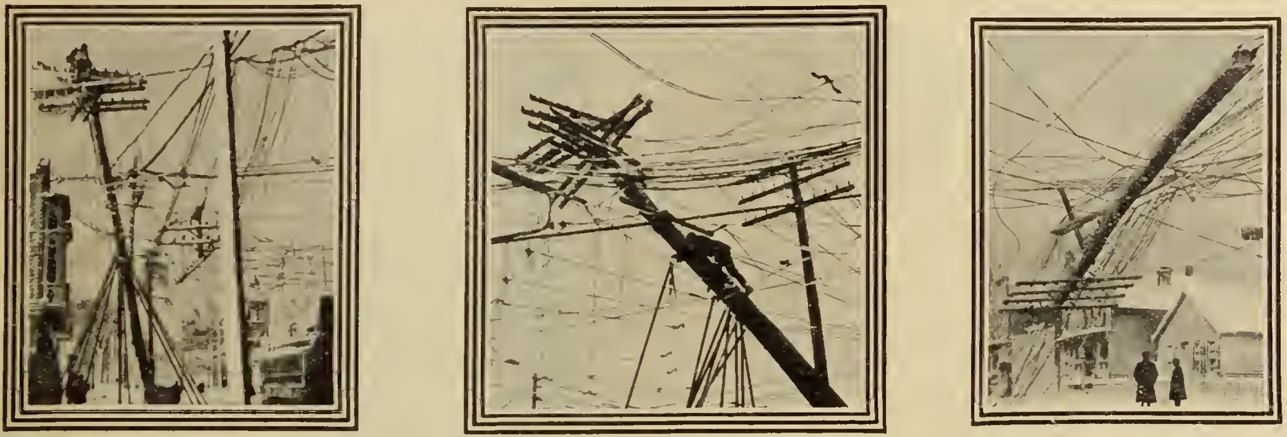
N. Y. Office, 30 Church St., Hudson Terminal Bldg.



Showing Effects of Snow and Ice on Overhead Wires in Cleveland, Ohio

Are You Insured Against This Loss?

Millions of dollars were lost in Cleveland, O., and vicinity during last November's blizzard in the manner shown in the pictures.

Why not insure your company against such loss by installing your electric wires underground?

We are the only company in Canada able to manufacture and install electric cable systems of this kind complete with the necessary cable terminals, junction boxes and other accessories.

Now is the time to plan this work. Write our nearest office to-day.

Standard Underground Cable Co. of Canada, Limited
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Montreal, Que. Boston, Mass. Seattle, Wash. Winnipeg, Man.

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Speaking of Standards

We know as well as the next fellow how nice it would be to make a piece of apparatus; good, bad or indifferent, standardize it and sell it, but that's not the Cutter way.
WITH US THE SPECIAL CIRCUIT BREAKER OF TO-DAY IS THE STANDARD CIRCUIT BREAKER OF TO-MORROW.
That is why we lead in circuit breaker development.
From Uncle Sam down the I-T-E Circuit Breaker is the first choice.
We have said before, and we repeat, there are two classes of circuit breakers, I-T-E—and others.
If you want I-T-E Circuit Breakers, say so.

THE CUTTER COMPANY **Philadelphia**

The
Lachute Shuttle Co.
Limited
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Manufacturers of

CROSS ARMS made from straight grained Douglas Fir, Long Leaf Yellow Pine and Red or Norway Pine.

The largest manufacturer of Cross Arms in the East.

INSULATOR TOP PINS made from Birch, Elm, Locust and Oak.

BRACKETS made from Birch and Oak.

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SPECIAL PINS for HIGH VOLTAGE TRANSMISSION made from Locust and Oak, all kinds and sizes.

All products boiled in Parafine and Stearine or Creosoted if wanted.

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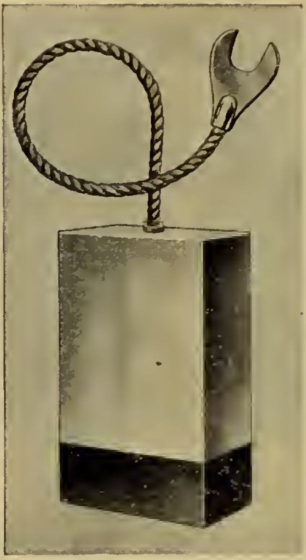

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Becker brushes are famous for their fine texture, perfect lubrication and freedom of grit or materials liable to damage the commutation.

Becker brushes are long lived and are made in every size and shape.

Get our catalogue containing prices.

Send us your inquiries for any style of Gauge — Carbon or Magneto Brushes

Becker Brothers
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CHICAGO, ILLINOIS.

XCELADUCT GALVANIZED and ORPENITE ENAMELLED CONDUITS

These two brands of Interior Conduits represent the acme of Canadian made products.

MANUFACTURERS OF XCELADUCT AND ORPENITE CONDUITS

XCELADUCT — this exceptionally high-grade galvanized conduit is made of easy-bending spellarized steel tubing. Copper subcoat and a zinc coating doubly protects it against rust, corrosion and atmospheric conditions.

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In both brands of conduits the interior presents a smooth enamelled surface, which makes fishing rapid and easy—clean threads.

If your jobber does not carry a stock—write us.

The Sign of QUALITY FIRST

THE ORPEN CONDUIT
MANUFACTURING COMPANY OF CANADA
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ALWAYS SPECIFY "EXCELADUCT" OR "ORPENITE."

Superior

Pole Line Material

We can furnish any quality of arms, pins, brackets, or pole line hardware you call for if you can wait for factory shipment, but stock only which carries our guarantee.

Superior

This includes: Washington Fir not less than 85% heart, Georgia Pine—Long Leaf—not less than 75% heart Kyanized—Spruce. Pins and Line Hardware—A T and T specifications.

STUART-HOWLAND COMPANY
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Knife and Snap Switches

Are Dependable

Use Them on Your Next Installation

and get acquainted with their many superior points.

Write for descriptive literature

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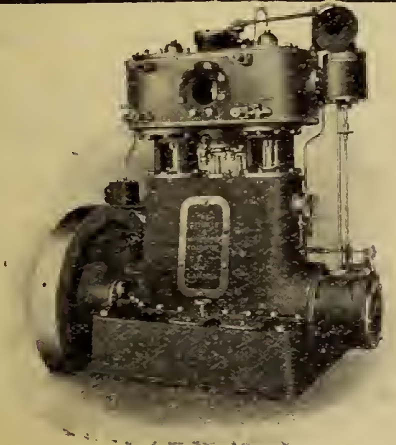
The largest Electrical Supply House in the West



Vertical, Forced Lubrication

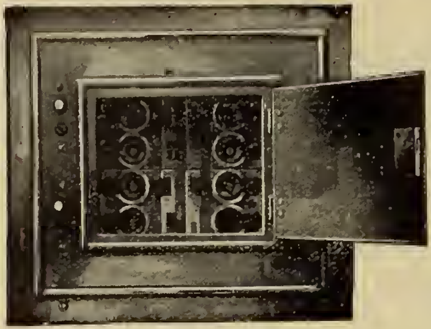
Quick Revolution Engines

With Combined Throttle and Expansion Governor

These engines are giving excellent service wherever installed. They are built for service and are economical in consumption of steam and require little or no attention while running. The materials used are in accordance with British Admiralty Specifications. Ask for detailed information.

All Engines are Tested under Steam before leaving our works

THE GOLDIE & McCULLOCH COMPANY, LIMITED
Head Office and Works: Galt, Ontario, Canada
Branches:—Toronto Montreal Winnipeg Vancouver and St. John, N. B.



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Save Cost of Switch Box and Plates.

Push Button instead of knife switches eliminates all danger of accidental contact with live parts, besides assuring longer service, as it is well known that push button switches far outlast knife switches. These new cabinets are much superior to the regular panels and cabinets, they occupy less space and are lower in price. Lock type switches may be substituted for use in public halls, etc. Note the prices. Cabinets only.

Prices

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511	2	$3.50	515	10	$5.50
512	4	4.00	516	12	6.00
513	6	4.50	517	14	6.50
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Write for Bulletin and Discounts

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Over 297,000 Sold

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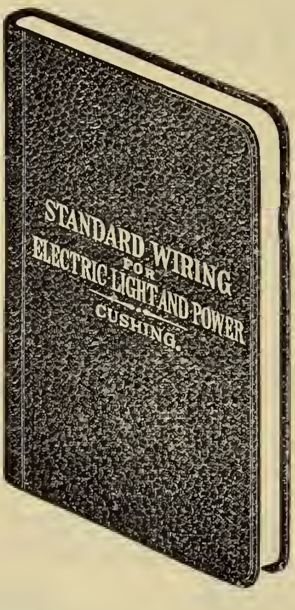

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is the only book on Electric Light and Power Wiring and Construction endorsed and recommended by every Board of Fire Underwriters in the United States and Canada, because it is the only one kept strictly up-to-date and revised every year in accordance with every rule and requirement of the

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which it contains, explained and illustrated. The 1914 Edition has been completely revised from the first to the last page, and contains new illustrations, tables and diagrams in accordance with the latest and best practice.

"It settles disputes and, if referred to before wiring, prevents disputes."

Sent to any address, postpaid, on receipt of **$1.00** Leather Cover Pocket Size

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"The Best Book on Wiring Ever Produced"—E. T. Birdsall, M.E., A.I.E.E.

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SIMPLEX QUALITY

A Text Book for Gift Makers

at any time is our new booklet, "The Dainty Way to Keep House."

¶ It has interested thousands in lamp socket cooking and heating appliances of Simplex Quality.

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SIMPLEX ELECTRIC HEATING CO.

Mfrs. of Everything for Electric Heating and Cooking

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Refilled by simply bending the fuse over the metal cross piece and screwing the cap in place.

No threads on the fibro tube to strip off or screws, rivets or clamps to get loose. Merely two holes in the fibre tube and held in place by the cap. This metal to metal contact is not affected by the swelling or shrinking of the fibre shell.

Daum Fuses are making good every day.

CATALOGUE NO. 17 for the asking

Sole Manufacturers

A. F. DAUM COMPANY, PITTBURGH, PA.

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Dust and Oil Rings, Buffers, Lubricating Pads, Wicks for Fan Motors, and felts of every kind for electrical and mechanical uses.

The Booth Felt Co., Limited

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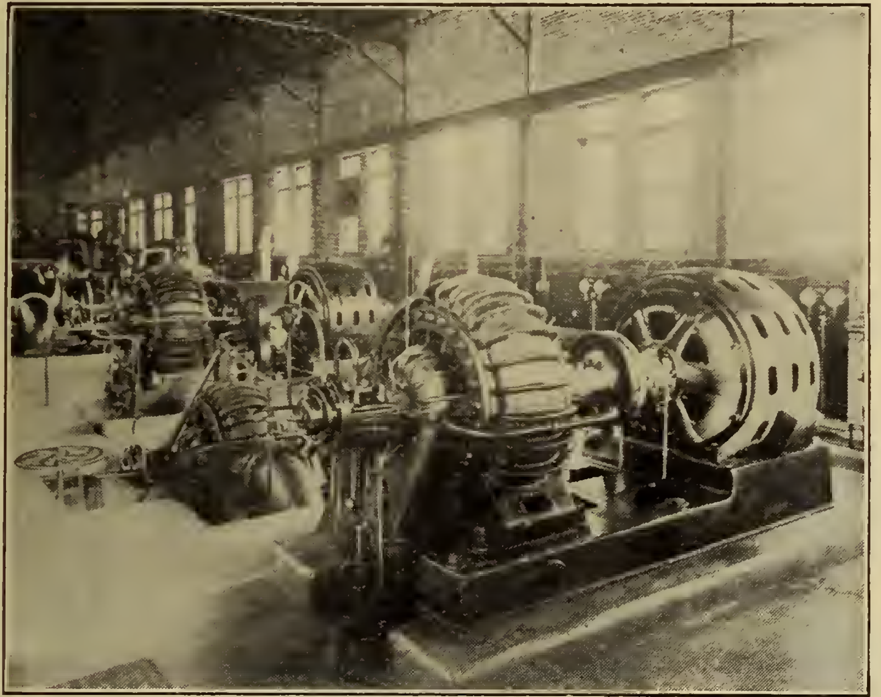

Three 10,000,000 Gallon Pumps against 200 lbs. pressure supplied to the Montreal Power & Water Co.

High Efficiency

Water-works Pumps

One of the pumps shown in the picture was installed by us two years ago and we have since installed the other two shown in the same picture.

Repeat Orders Speak For Themselves

BOVING & CO. OF CANADA, LIMITED

TORONTO VANCOUVER *Works* LINDSAY, ONT.

ALUMINUM

ELECTRICAL CONDUCTORS

Ingot Sheet Wire Rod Tubing

Northern Aluminum Co. Limited

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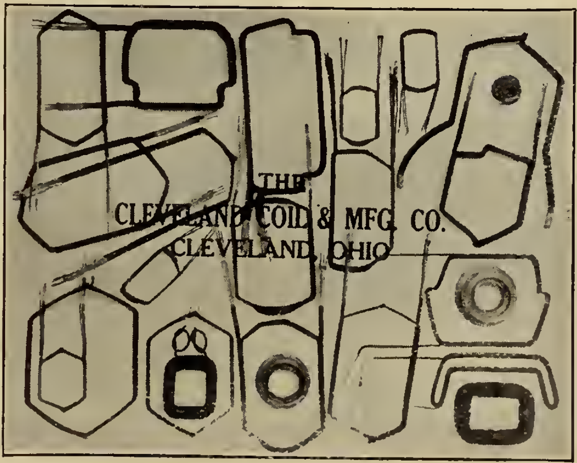
Toronto, Ont.



No. 6024—14 in. diameter.
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Artistic and Efficient Lighting

When properly mounted

Moonstone Glass

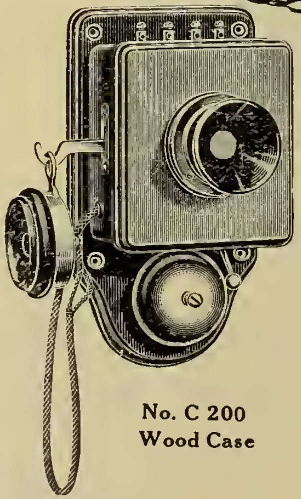
with its flood of pleasing radiance adds a grace to any interior that is amazing.

Consult our Engineering Department with your lighting problems.

No. 6022—16 in. diameter.

Jefferson Glass Co., Limited, Toronto, Ont.

BRITISH MADE
STERLING
TELEPHONES



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Wood Case

Cheap Phones with Induction Coils C Battery Ringing

No. C206
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BRITISH COLUMBIA.—Cope & Son, Ltd., Water Street, Vancouver.

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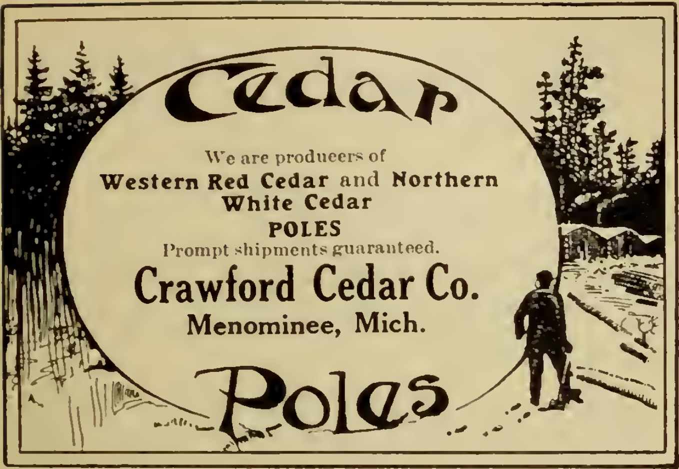

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Western Red Cedar and **Northern White Cedar**
POLES
Prompt shipments guaranteed.

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Our
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will meet your most exacting requirements. You'll find them straight, strong, sound-butted, and shipped on time. Let us quote you.

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That Stands the Test of Time and Weather

WE MAKE ALL ARTICLES REQUIRED

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Send us your specifications to quote on.

All Styles of:
Bolts, Nuts,
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Lowest Prices—
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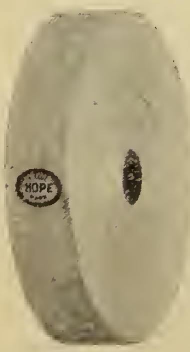

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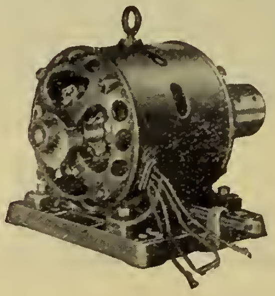

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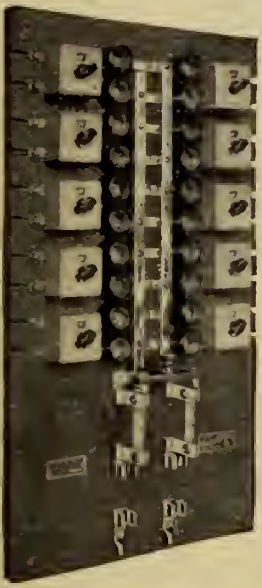

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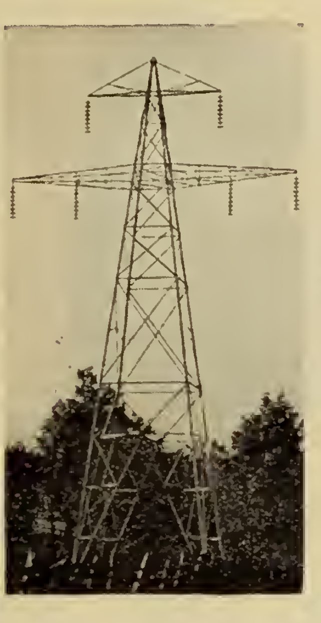

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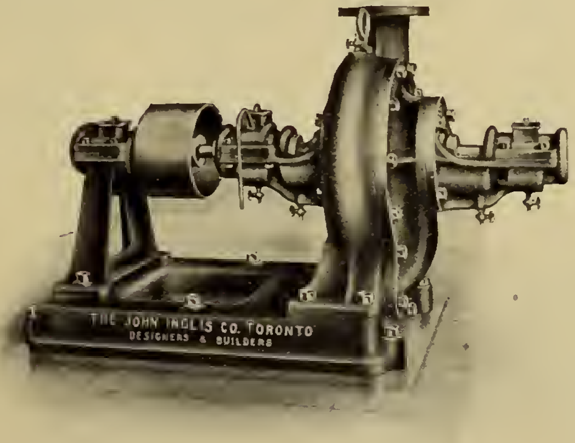

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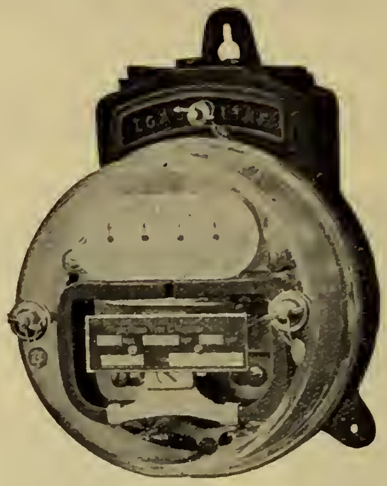

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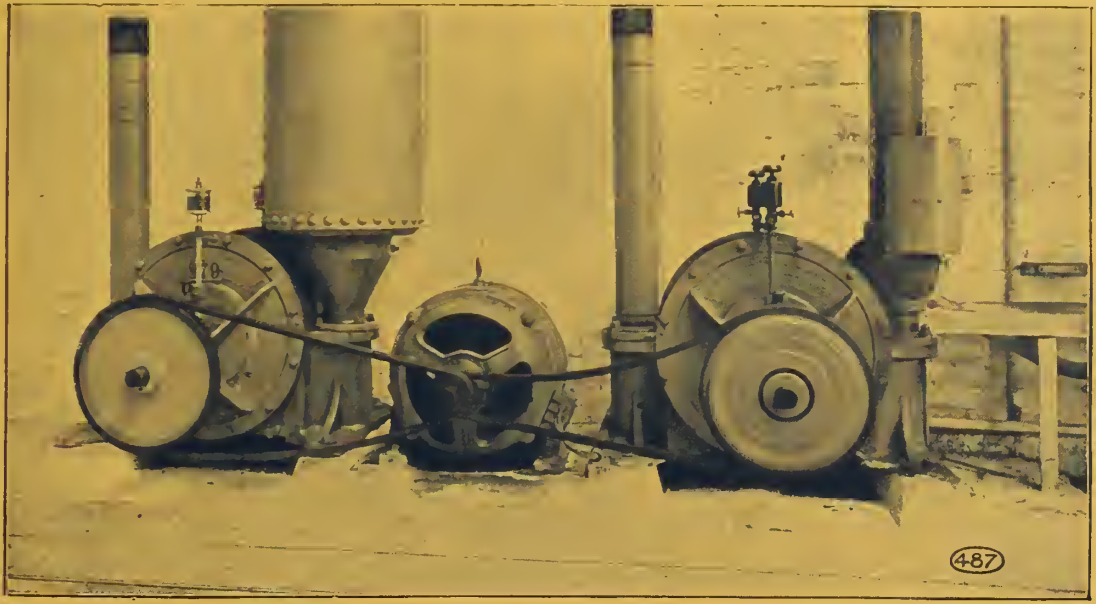

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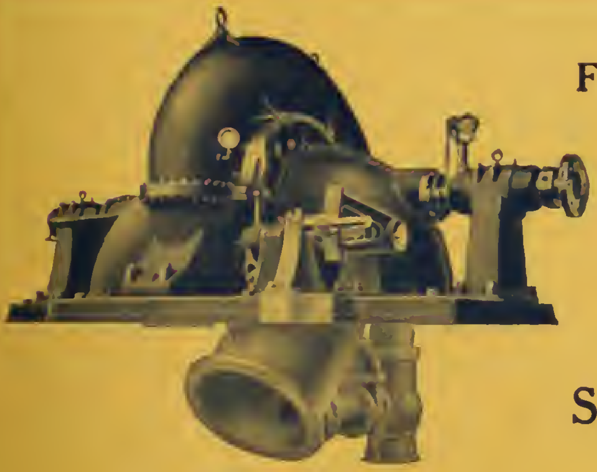

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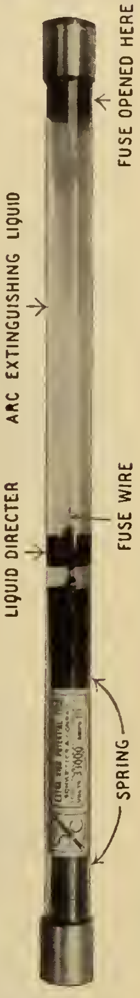

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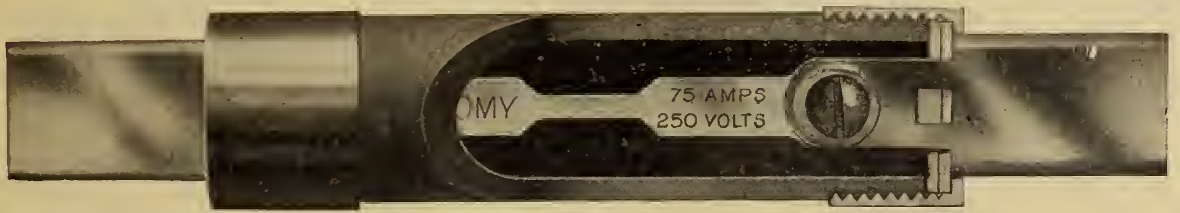

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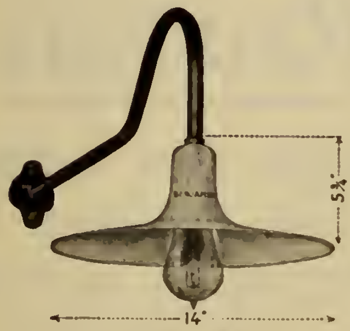

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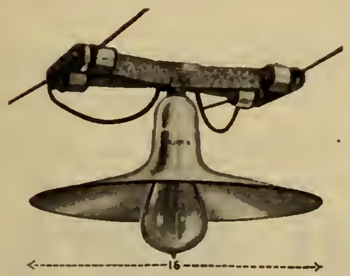

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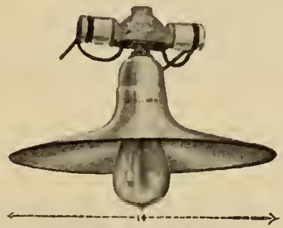

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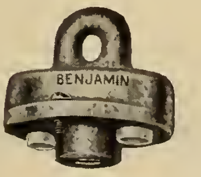

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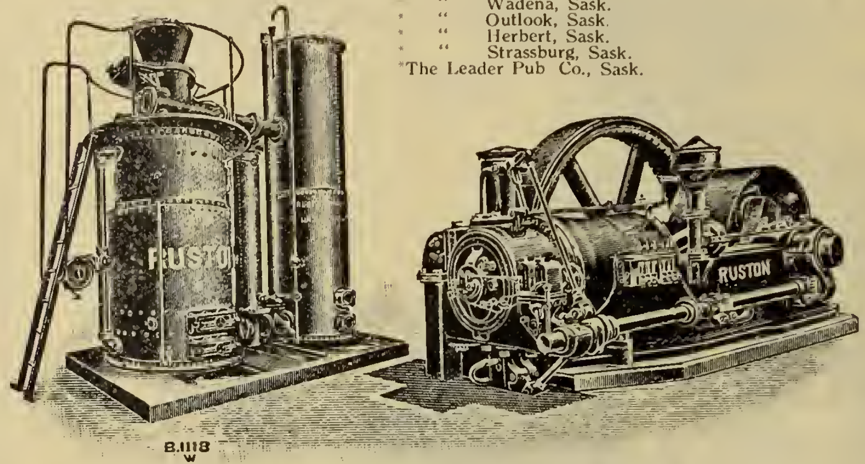

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Japanned or Galvanized

Galt Malleable Iron Co., Limited

Galt, Ontario

We specialize in this class of work.

A NEW LAMP—A NEW PROCESS

THE ELMAIN EFESCA WIRE LAMP

The Filament is ANNEALED. If you have handled wire, you will know that a hard wire breaks easy, that if you anneal it, it will not break. The Annealing is the secret of this lamp's unparalleled lasting quality.

But you will find many lamps that *last* because they have been made tough at the expense of efficiency.

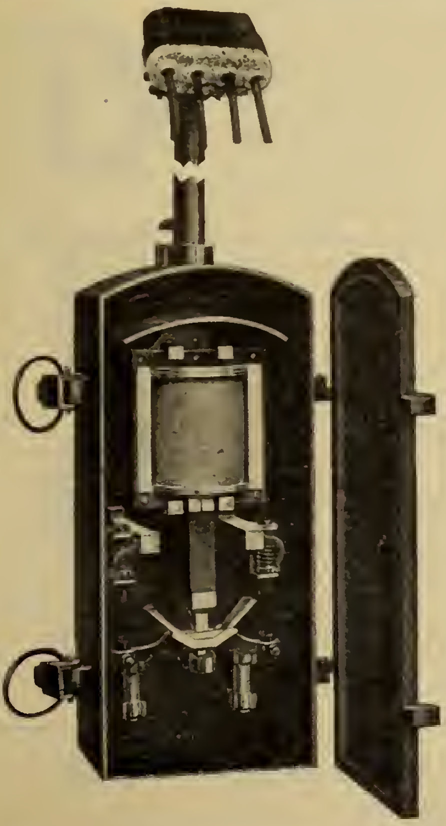
NOTE THIS—The efficiency of this lamp is 1.1 Watts per candle.
It is remarkably tough when you first get it.
It is tougher after 200 or 300 hours' run than when first put in service.
And it's LOW IN PRICE.

Where else can you get this combination?

Agents wanted everywhere. Write to-day, state your probable requirements during the ensuing year and get the exclusive rights for your town before the other fellow does. **You can beat him in Price and Quality.**

SPECIAL PRICES TO CENTRAL STATIONS

Solenoid Switches for Remote Control of Street Lights



This cut shows our Type 17 H.E.P. Solenoid switch which was adopted by the Hydro-Electric Commission of the Province of Ontario and used by them in a large number of Ontario towns.

Orders are received from all the Provinces.

This switch is no experiment. The fact that it has been adopted by the Hydro-Electric is proof of its success.

No springs, swivels or other complicated mechanisms to give trouble. They close magnetically and are opened by gravity assisted by the tension of the laminated copper contact. All arcing is taken up on the carbons.

Increase the efficiency of your system and decrease the cost of installation by using our Type 17 H.E.P. Solenoid Switches, which are suitable for any frequency on multiple circuit or D.C. Series circuit.

Essential for Modern Street Lighting Methods. Let us send fuller particulars.

How About Your Electric Repairs?

We have expert repair men available at a moment's notice to make repairs at your plant or at our works. They have repaired some of the largest machines in the country.

If you you want complete, quick service, wire us.

The Electrical Maintenance and Repairs Co.,
Limited
162 West Adelaide St., Toronto
Adelaide 902-903
Manager, Beach 1723
Nights, Sundays and Holidays.
Superintendent, Beach 1930

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The Best Endorsement of the value of the "Electrical News" as an advertising medium is the above List of Advertisers

GALVADUCT

New G. T. P. Hotel at Edmonton, Alta.
A "GALVADUCT" Building

"GALVADUCT"

The most perfect interior construction conduit on the market.

Recognized as the standard of high quality.

Always specify Galvaduct or Loricated conduits

Everywhere in every land and in all classes of buildings you will find these famous conduits. They make safe and permanent channels for your wiring.

"LORICATED"

A high-class interior construction conduit of the enamelled type, proof against acid or other corrosive agents.

If your jobber cannot supply you—write us

Conduits Company Limited

Toronto - Montreal

LORICATED

Our Improved
Type "K" Meter.

Why Not Buy Canadian made Meters?

" Packard " Meters have been manufactured in Canada for the past fifteen years.

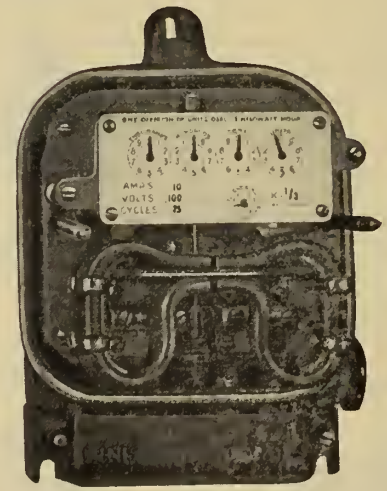
There are over 70,000 in use at the present time throughout Canada.

Packard

Government re-inspections have proven the "Packard" to be a meter that will ***stand up*** and retain its accuracy of calibration over years of service.

Our improvements are all up-to-date and there is no better meter made anywhere.

The " Packard " may cost a little more at the start, but it saves money in the end.



Showing Improved
Magnet Support.

LARGE STOCKS CARRIED AT

St. Catharines and Winnipeg;
St. John Railway Co., St. John, N.B.;
General Supplies, Limited, Calgary, Alta.;
Rudel-Belnap Machinery Co., Canadian Express Bldg., Montreal, Que.

The Packard Electric Co., Limited

Factory at St. Catharines, Ont.

General Sales Office,
Traders Bank Bldg., TORONTO

N. W. Office and Warerooms,
WINNIPEG

KEYSTONE

Switchboard — Portable

Voltmeters
Ammeters
Wattmeters
Inkless Record Recording Instruments

Absolutely *High Grade*
Permanent Accuracy.

Alternating and Direct Current.

THE MASCO COMPANY
LIMITED
60 Church St., Toronto

The
Lachute Shuttle Co.
Limited
Lachute Mills, Que.

Manufacturers of

CROSS ARMS made from straight grained Douglas Fir, Long Leaf Yellow Pine and Red or Norway Pine.

The largest manufacturer of Cross Arms in the East.

INSULATOR TOP PINS made from Birch, Elm, Locust and Oak.

BRACKETS made from Birch and Oak.

POLE STEPS made from Oak.

STRAIN PINS made from Second growth Hickory.

SPECIAL PINS for HIGH VOLTAGE TRANSMISSION made from Locust and Oak, all kinds and sizes.

All products boiled in Parafine and Stearine or Creosoted if wanted.

CORRESPONDENCE SOLICITED

O-B Bushings

Are made with the utmost care. Quality of material and workmanship do not vary with size. The largest transformer bushings and the smallest wall tubes are made along the lines of our watchword—

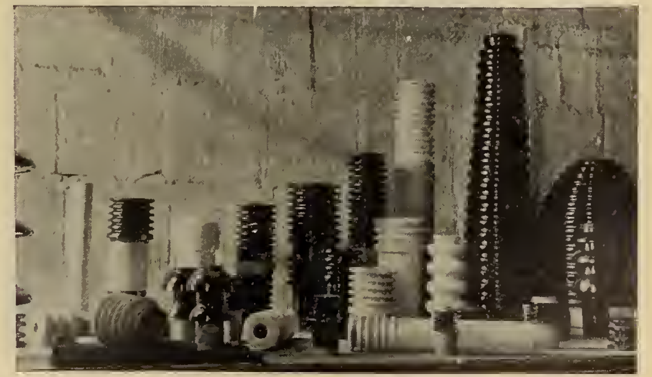
"Quality First"

The illustrations show a few of the many styles that we are prepared to furnish.

If you need porcelain insulation, we can supply it.

The Ohio Brass Co.

Mansfield, Ohio, U. S. A.



This is the ☛
letter

Civic Utilities
EMBODYING
THE LIGHT, HEAT, POWER AND WATER
DEPARTMENTS
Kingston, Ontario, Canada.

GENERAL OFFICES AND WORKS
QUEEN STREET
PHONE 197

OFFICE OF THE GENERAL MANAGER
C. C. FOLGER,
GENERAL MANAGER

Kingston, February 19th, 1914.

Messrs. Dietrich Limied,
Contracting Engineers,
Montreal, Que.

Gentlemen,

We are glad to express our satisfaction with the careful and expeditious way in which you carried out your Underground Conduit Contract in this City, during October, November and December 1913.

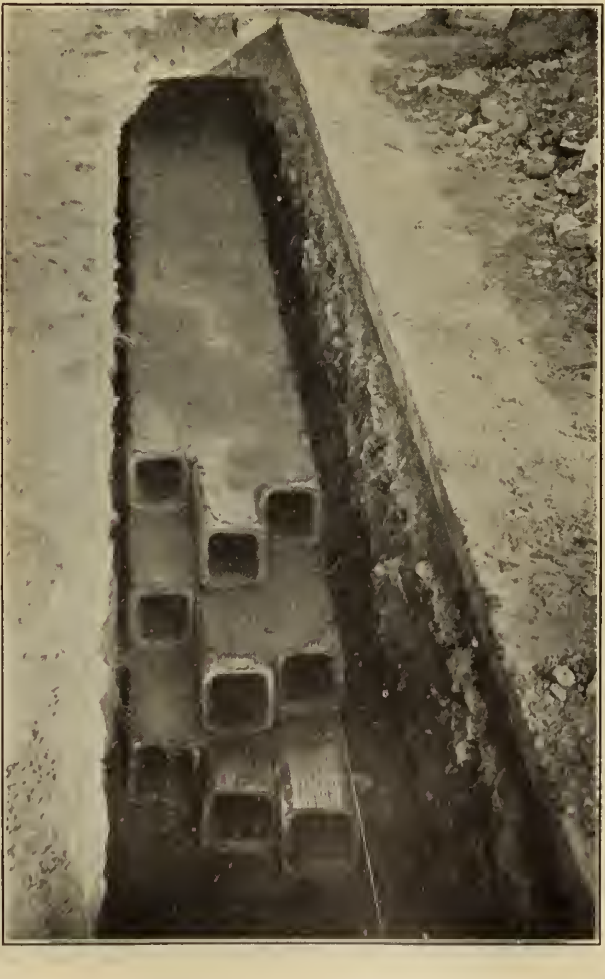
This work covered the entire business district on both sides of the street, and was done under the specifications and subject to the approval of the Ontario Hydro-Electric Power Commission.

Yours very truly,

A. E. Ross M.D.
Chairman.

C. C. Folger
Gen. Manager.

This is part of
the job



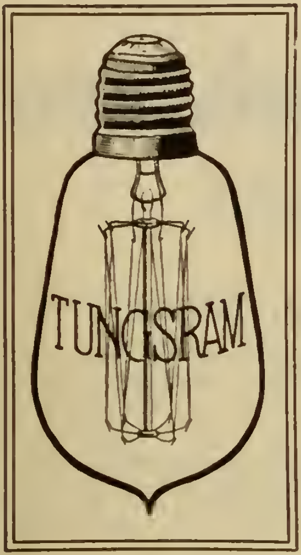
Nuff sed!!

Dietrich LIMITED

Contracting Engineers

300 Read Bldg.

Montreal

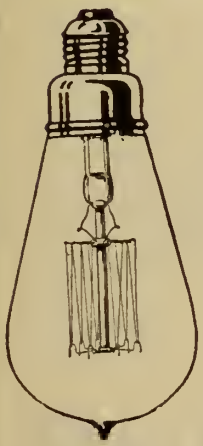


"TUNGSRAM"

THE
strongest filament
PERFECT
satisfaction to consumers
LAMPS
for all Lighting purposes.

All Sizes and Voltages carried in stock at Montreal,
Also for import.

Ontario Selling Agent
WALTER H. WARRINGTON
406 Tyrrell Building
Main 2466 TORONTO
Representing
The Perkins Electric Company Limited, Montreal, P.Q.
Brandt-Dent Company, Watertown, Wis.
Crown Novelty Company, Chicago, Ill.
Flexible Conduit Company, Guelph, Ont.



Shuman-Wire Drawn Tungsten Lamps
You Should Sell Them

Think what it would mean if you could say "Here, Mr. Man, is a written guarantee for this Tungsten Lamp."

Stock **Shuman-Wire Drawn Tungsten Lamps** and you will sell a guaranteed article.

Full particulars of guarantee on application

Geo. H. Shuman Electric Co.
6th Floor Blumenthal Building
Montreal

Electrical Books
FOR SALE

"Tesla High Frequency Coil," by Haller & Cunningham. Published in 1910 by D. Van Nostrand & Company. Price $1.25.

'Elementary Telegraphy," by Pendry. Published in 1910 by Whittaker & Company. Price $1.00.

'Direct and Alternating Current Testing," by Bedell. Published in 1909 by D. Van Nostrand & Company. Price $2.00.

"A Laboratory Manual of Alternating Currents" by John H. Morecroft, E.E. Published in 1912 by Renouf Publishing Company. Price $2.00.

"Electricians' Operating and Testing Manual," by Henry C. Horstmann and Victor H. Tousley. Published in 1910 by Frederick J. Drake & Company. Price $1.50.

"Telephony," by Samuel G. McMeen and Kempster B. Miller. Published in 1912 by the American School of Correspondence. Price $3.00.

"Elevators, Hydraulic & Electric," by Calvin F. Swingle. Published in 1910 by Frederick J. Drake & Company. Price $1.00.

"The Electric Motor and Its Practical Operation," by Elmer E. Burns. Published in 1912 by Joseph G. Branch Publishing Company. Price $1.00.

"Electric Wiring & Lighting," by Charles E. Knox, E.E. Published in 1913 by the American School of Correspondence. Price $1.50.

"Electric Arcs," by Clement D. Child, Ph.D. Published in 1913 by D. Van Nostrand Company. Price $2.00.

"Conversations in Electricity," by Branch. Published in 1908 by the Branch Publishing Company. Price $2.00.

'A. C. Machinery," by Esty. Published in 1912 by the American School of Correspondence. Price $4.00.

'Wireless Telegraphy and Wireless Telephony," by Ashley-Hayward. Published in 1911 by the American School of Correspondence. Price $1.50.

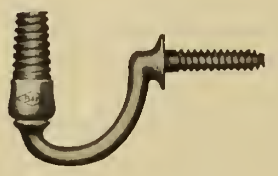
"American Electricians' Handbook," byTerrell Croft. Published in 1913 by McGraw-Hill Book Company, Inc. 750 pages, illustrated. Price $3.00.

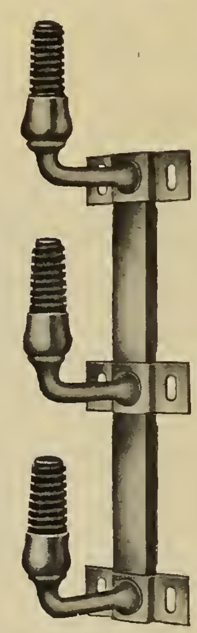
Order at once if interested.

Book Department
Electrical News
220 King Street West - Toronto, Ontario

Pole Line and Bracket Hardware

PRESSED STEEL CONSTRUCTION SPECIALISTS





B. & K. Bracket Hardware

The B. & K. BRACKET HARDWARE is the result of years of experience in the electric field. It has eliminated all the objections usually found in this class of material for the following reasons:

Impregnated locust or oak cobs slowly forced into cold drawn steel shells under a pressure of several tons. This combination secures the desirable wood thimble feature, and precludes the possibility of cobs splitting.

Wall plates are made of pressed steel and open hearth channel, and brackets of hot forged open hearth steel.

Ally B. & K. bracket hardware is hot riveted by our patented electric riveters.

No metal portion of the bracket touches the insulator, thus insuring great insulating efficiency.

The wood cob eliminates any possibility of insulators breaking, due to expansion. Our construction assures a factor of strength far in excess of commercial requirements.

B. & K. brackets combine the advantages of high insulating qualities, uniformity of construction, correctness of design and maximum strength.

All B. & K. bracket hardware is galvanized by the hot process.

Our new complete catalogue will be ready for distribution shortly.

Write for a copy.

B. & K. Guy Clamps

Of the several types of Guy Clamps on the market to-day, practically all are friction grips, depending for their hold entirely upon the uniform making up of the nuts.

A clamp that will hold a wire rope up to the breaking point has been a long felt need.

The B. & K. Type has been designed to fill this need. The B. & K. Method of holding is entirely different from any in use to-day.

The clamp need not be taken apart; the rope is merely placed in the recesses of the pressed steel portion. The bolts turned transversely and the nuts made up. This gives a powerful and unyielding hold. A more substantial bolt is used than in the ordinary Guy Clamp, thus eliminating the danger of stripping the thread.

The case portion is made from drawn steel of sufficient gauge to retain its shape when the breaking point of the rope is reached on a direct pull.

The one-bolt is made in five sizes, to take ¼ in to ⅜ in. strand—the two-bolt clamp in two sizes, for 5/16 in. to ⅜ in. strand.

The Barnes & Kobert Mfg. Co.

New Haven, Conn.

All Records Smashed—

Always Specify

"Xceladuct"

or

"Orpenite"

In the report of the Underwriters Laboratories Inc., Chicago, for the three months ending February 28, 1914, the Orpen Conduit Manufacturing Company, of Toronto, manufacturers of XCELADUCT and ORPENITE, were shown to have no demerit marks on either the galvanized or enamel product.

"XCELADUCT"

GALVANIZED CONDUIT

and

"ORPENITE"

ENAMELLED CONDUIT

is shown to rank highest of all Canadian or American conduits for period ending six months. The flawless condition of our product is due to the careful scrutiny exercised at every stage of the work.

"XCELADUCT"—an exceptionally high grade galvanized conduit made of easy-bending spellarized steel tubing. A copper subcoat and zinc coating doubly protects it against rust, corrosion and all atmospheric conditions.

"ORPENITE" CONDUIT—easy-bending spellarized steel tubing covered with a specially prepared coating of enamel, making it proof against rust and all weather conditions.

These two brands of Conduits present a smooth enameled interior and clean threads, permitting of rapid fishing.

If your jobber does not carry a stock write us.

MANUFACTURERS OF XCELADUCT AND ORPENITE CONDUITS

The Orpen Conduit Manufacturing Company of Canada

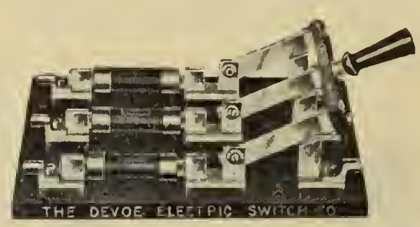
Toronto **Montreal**

"Devoe" Means Quality

An examination of **"Devoe"** Standard Panels, Switches and Switchboards will convince you they are the best made.

Type "A"

Every **"Devoe"** product is built for efficient service under actual operating conditions.



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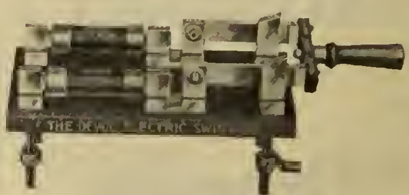
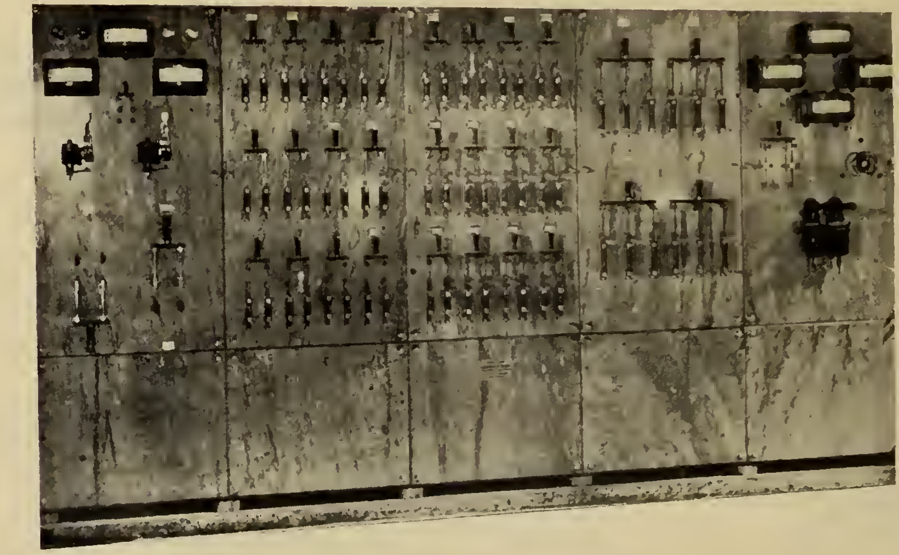


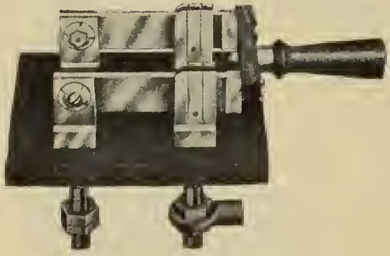
Cut No. 2005

PANELS, SWITCHES, SWITCH-BOARDS built to any specification.



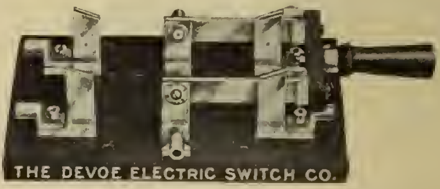
When specifying insist on **"Devoe"** PANELS SWITCHES and SWITCH-BOARDS.

"WE SPECIALIZE IN SWITCH BOARDS"



Cut No. 268

"Devoe" Form Box



**The
Devoe Electric
Switch
Company**

**Office and Factory:
157 Craig Street West,
Montreal, Que.**

Across Canada with the

IMPERIAL WIRE & CABLE CO.

LIMITED

Toronto - MONTREAL - Winnipeg

Fourth of a series of advertisements showing buildings of national importance which have been wired with the Imperial Wire & Cable Co.'s, Limited, wires.

This picture shows the Electric Railway Chambers Winnipeg

This building was wired with "Imperial Higrade" Rubber Insulated Wire

Architects	Pratt & Ross, Winnipeg
Engineers	Neiler, Rich Co., Chicago
Electrical Contractors	Schumacher Gray Co., Winnipeg

Northern Electric Company

LIMITED

Montreal Halifax Toronto Winnipeg Regina Calgary Edmonton Vancouver Victoria

Successors to IMPERIAL WIRE & CABLE CO., LTD.

Correspondence previously addressed to Imperial Wire and Cable Co. at 611 C.P.R. Building., Toronto, and 902 Electric R. Chambers, Winnipeg, should now be addressed to the Northern Electric Company, Limited, Simcoe St., Toronto, and 599 Henry Ave., Winnipeg.

CANADA WIRE & CABLE CO. LIMITED
CANADA
TORONTO CANADA

A chain is no stronger than its weakest link—and

a transmission system is no more efficient than the weakest spot in the line.

The superior quality of raw material and our extreme vigilance during the course of manufacture are responsible for the reputation we have gained in the marketing of electrical wires and cables.

Get our quotations on

WEATHER PROOF COPPER and ALUMINUM Line Wire.

WEATHER PROOF COPPER CLAD Wire for series arc lighting.

RUBBER COVERED WIRES and CABLES.

RAILWAY and POWER FEEDER CABLES in COPPER and ALUMINUM.

COPPER TROLLEY WIRE.

COPPER CLAD WIRE (Duplex Metals).

GALVANIZED STEEL STRAND GUY WIRE.

Prompt shipments made from stocks carried at Toronto, Montreal Winnipeg and Vancouver.

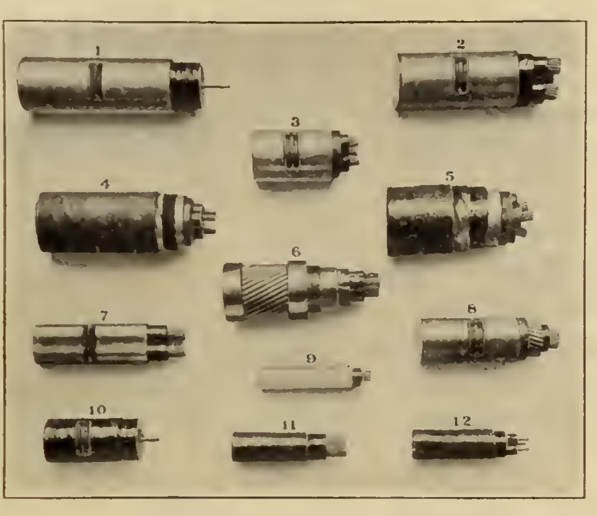
Canada Wire & Cable Co.
Limited
TORONTO **1160-1170 Dundas Street** **ONTARIO**

Sales Offices:

401 Lake of the Woods Bldg.
Montreal, Que.

A. E. Esling, 150 Princess St.
Winnipeg, Man.

Macdonald, Marpole Co., Ltd., 427 Seymour St., Vancouver, B. C.



1, 2—Varnished Cloth Insulated Lead-Covered Cable.
3—Paper Insulated Lead-Covered Cable.
4—Paper Insulated Steel-Tape-Armored Cable.
5—Rubber Insulated Steel-Tape-Armored Cable.
6—Varnished Cloth Insulated Steel-Wire-Armored Cable.
7—Flat Duplex Paper Insulated Lead-Covered Cable.
8—Concentric Duplex Paper Insulated Lead-Covered Cable.
9—Varnished Cloth Insulated Asbestos Covered Cable.
10, 11, 12—Varnished Cloth Insulated Braided Cables.

Our Argument

when thus soliciting your patronage for our products is based principally on these three facts:

First, the superior and sustained quality of STANDARD products;

Second, their great variety which enables us to meet your every requirement in the way of electric wires and cables and their accessories;

Third, our extensive and up-to-date facilities which enable us to meet your emergency demands, shipping promptly from extensive stocks.

The following is an outline of our principal products:

Wire Rods

Bare Wire and Cable
Trolley, Line and Transmission Wires

Standard C. C. C. Wire
(Colonial Copper Clad)
Bare and Insulated

Magnet Wire
All sizes, shapes and finishes

Weatherproof Wire
All sizes and finishes

Rubber Insulated Wire
For all kinds of service

Varnished Cloth Cable
Braided or Lead-Covered

Fibre Lead-Covered Cable
Telephone and Telegraph Service

Paper Lead-Covered Cable
Dry or Saturated Cores

Rubber Lead-Covered Cable
For all kinds of service

Armored Cable
Steel-Wire and Steel-Tape-Armored

Cable Terminals
(D. O. A.) Outdoor,
(D. S.) Indoor Service

Cable Junction Boxes
For A. C. or D. C. Systems

"Ozite" Insulating Compounds
For Joints, Terminals, Junction Boxes

Insulating Tapes and Sheets

Jointing Supplies

Cable Hangers and Supports

Cable Installations

Detailed information, samples, estimates or prices of any of the above products will be cheerfully and promptly supplied upon request to our nearest office.

Standard Underground Cable Co. of Canada, Limited
Hamilton, Ont.

Montreal, Que. Boston, Mass. Seattle, Wash. Winnipeg, Man.

Hold On

That is what you want your Rail Bonds to do. There are several kinds of bonds that will do it. There is *one* kind that not only will hold on, but absolutely will not corrode at the terminals.

Electric Welded bond terminals are guaranteed.

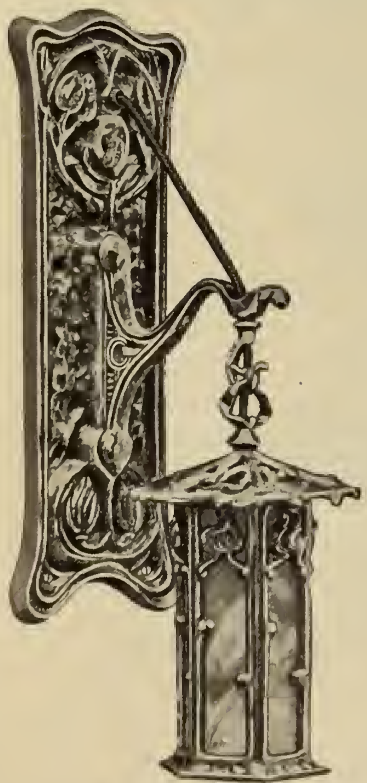
The Electric Railway Improvement Co.
Cleveland, Ohio

"SHAWMUT" Electrical Material

- Enclosed Fuses
- Fuse Blocks
- Porcelain Cutouts
- Fuse Wire and Ribbon
- Fuse Links
- Ground Connection Clamps
- Nipples and Couplings
- Stage Pockets and Plugs
- Metal Cable Clips, Etc.

Manufactured by
CHASE-SHAWMUT CO.
Newburyport, Massachusetts

FRANK G. SCOFIELD
RERESENTATIVE FOR ONTARIO
702 LUMSDEN BLDG. - TORONTO, ONT.



ANNOUNCEMENT!

Tungstolier Co. of Canada
Limited

We beg to announce that the business of the Tungstolier Co. of Canada has been taken over by this company.

We intend to carry in stock a large assortment of Electric Fixtures for both commercial and residential lighting, and being equipped with an up-to-date Fixture Factory, we feel that we can give you the very best service.

If you are not already familiar with our fixture products, we shall gladly send you descriptive catalogue with prices on request.

Kindly address your communications regarding Fixtures and Glassware to the Canadian General Electric Co., Limited, Fixture Section, Toronto, or to our nearest district office.

CANADIAN GENERAL ELECTRIC CO., Limited

Head Office: Toronto. District Sales Offices: Montreal, Halifax, Ottawa, Cobalt, Porcupine Fort William, Winnipeg, Regina, Saskatoon, Calgary, Edmonton, Nelson, Vancouver, Victoria, Prince Rupert.

Weatherproof Sockets and Receptacles

Amusement parks, summer gardens and open air theatres will soon be preparing for their opening. Lay in a stock of C.G.E. Weatherproof Devices now and be prepared to handle the big jobs on a rush basis.

Porcelain Sockets, with and without suspension hooks for guy wire construction.

Mogul Base Weatherproof Socket
1500 Watts—250 Volts

Porcelain Weatherproof Socket with half-inch cap for medium screw base lamps.

Porcelain and Moulded Material Pendent Type

650 Volt Aluminum and Brass Shell Weatherproof Sockets

C-G-E Reliable Wiring Devices are Sold by all Leading Dealers of Electrical Material

CANADIAN GENERAL ELECTRIC CO.

LIMITED

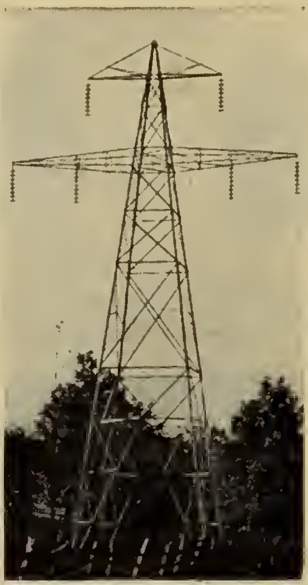
Manufacturers of Electrical Apparatus and Supplies
for Railway, Light and Power Purposes

Head Office: Toronto. District Sales Offices: Montreal, Halifax, Ottawa, Cobalt, Porcupine, Fort William, Winnipeg, Regina, Saskatoon, Calgary, Edmonton, Nelson, Vancouver, Victoria, Prince Rupert

Transmission Towers

Hot Galvanized or Painted

Estimates furnished on application



DOUBLE CIRCUIT TOWER
One of 3,300 Towers, furnished for the 300 mile Transmission Line of the Hydro Electric Power Commission of Ontario. Transmitting a 110,000 volt current from NIAGARA FALLS to the principal cities of ONTARIO. The largest single order of Transmission Towers ever placed.

The Canadian Bridge Co.
Limited
Walkerville, Ontario, Canada

MANUFACTURERS OF

Steel Railway and Highway Bridges
Structural Steel of all kinds

Power Cables

Manufactured by British Insulated & Helsby Cables, Limited

PAID-UP CAPITAL, $8,500,000.00

Head Office: Prescot, Eng. **Works at Prescot, Helsby and Liverpool**

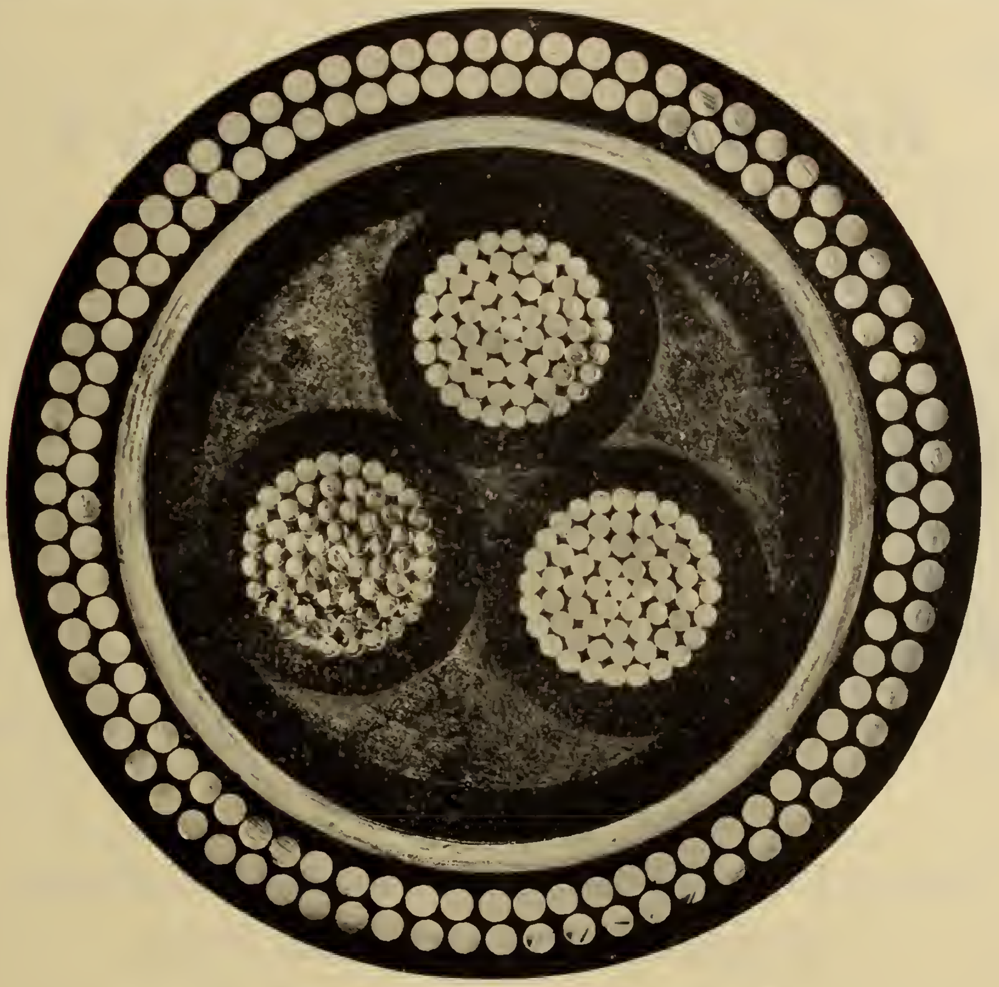


Illustration actual size of cable

500,000 C.M., Three-Conductor, Paper-Insulated, Lead-Covered, Double-Steel-Wire Armoured Cable, supplied to The Toronto Power Company to the specification of The Pearson Engineering Corporation of New York City.

Working Pressure 12,000 Volts

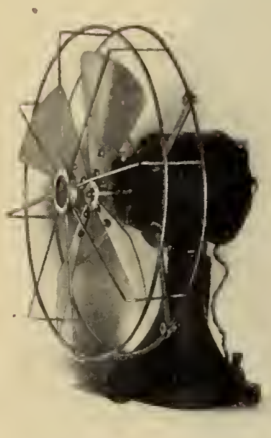
Sole Canadian Representatives:

Canadian British Insulated
Company, Limited

Montreal

The Fan Season Will Soon be Here

Are You Ready for it ?



12 inch Oscillating Fan,
60 cycle, A. C.

You remember the trouble you had last season on your deliveries by waiting until the last minute to send in your order ?

ASSURE EARLY DELIVERY

by sending us your orders today.

Every Fan We Send Out is Guaranteed and Complete with Cord and Plug

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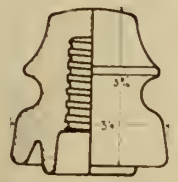
Sole Canadian Distributors for

"CONDOR" TUNGSTEN LAMPS AND REFLECTOR LAMPS

C. H. Basters & Company

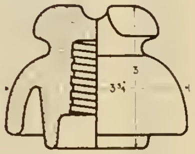
Toronto **22 College St.** **Canada**

Canadian Insulators

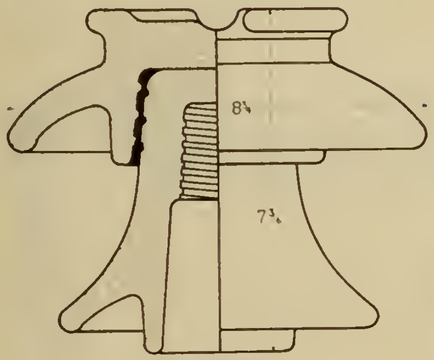


No. 105
6,600 Volts

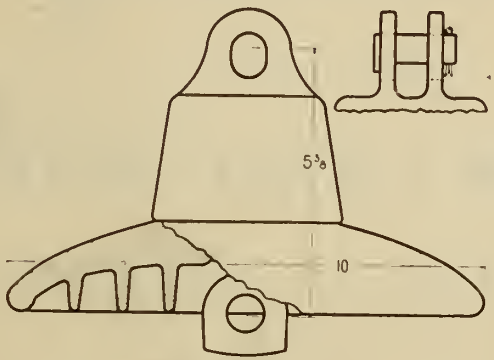
Hard Porcelain



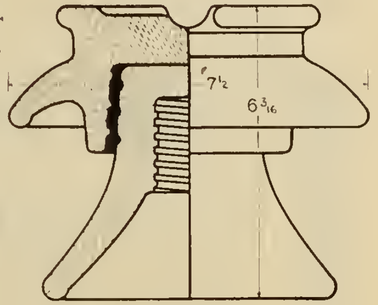
No. 100
8,000 Volts



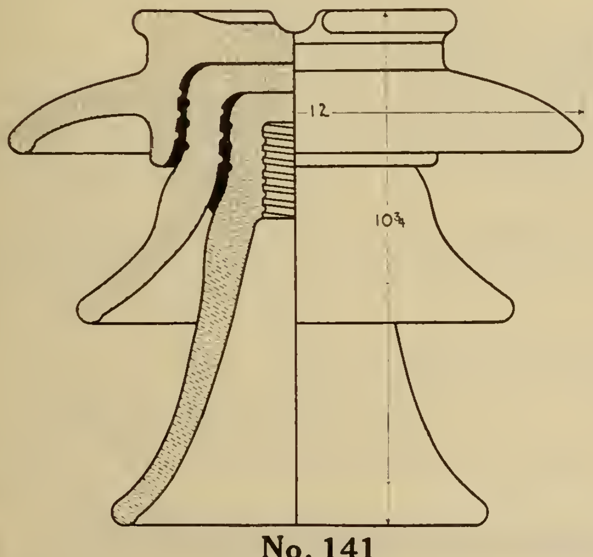
No. 133
30,000 Volts



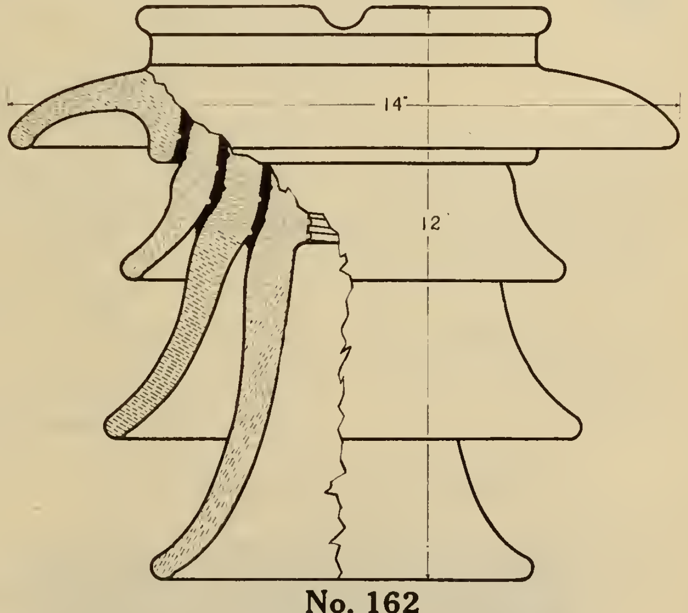
No. 189
Suspension Insulator
for all Voltages.



No. 136
20,000 Volts



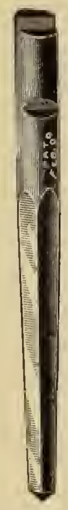
No. 141
50,000 Volts



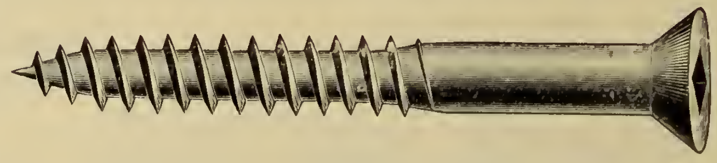
No. 162
60,000 Volts

Canadian Porcelain Co., Limited

Hamilton - Ontario

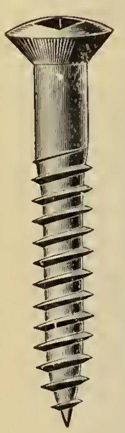


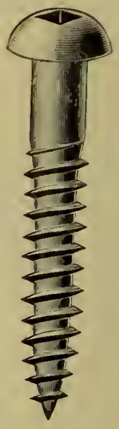
ROBERTSON SOCKET HEAD WOOD SCREWS



☛ SEE
THAT
SQUARE
HOLE

PAT. FEB. 2, 1909





THIS IS A REAL WOOD SCREW

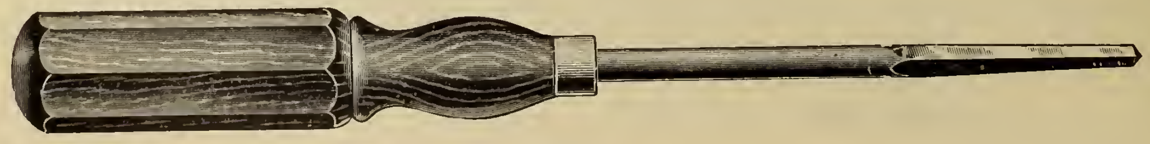
It is driven by a specially designed screw driver which fits snugly into the square hole in the head and there it stays until the work is done. This is the only wood screw of its type on the market and is especially adapted to all work connected with electrical wiring, fixtures, etc.

TRY IT

Place the screw on the driver, then you may reach out at arms length and drive it with one hand. For overhead work, or work between joists or under flooring it is invaluable. Saves time, labor and material. We make the drivers in all suitable styles.

Drivers Free With First Order

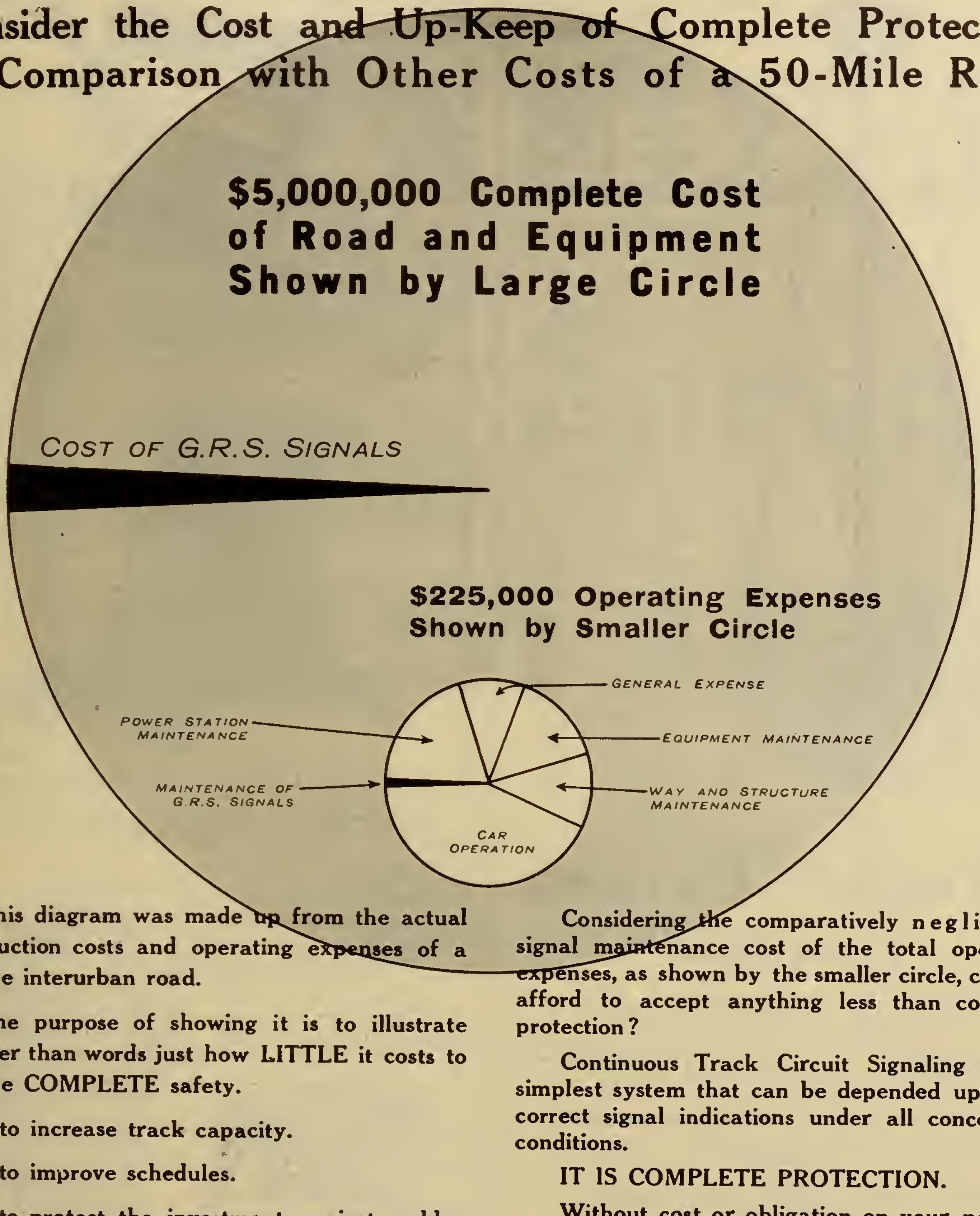
Our Goods are Guaranteed ***Our Prices are Right***



Samples, Prices and Catalogues on Application

The P. L. Robertson Manufacturing Co., Limited
Milton, Ontario

Consider the Cost and Up-Keep of Complete Protection in Comparison with Other Costs of a 50-Mile Road



This diagram was made up from the actual construction costs and operating expenses of a 50-mile interurban road.

The purpose of showing it is to illustrate stronger than words just how LITTLE it costs to provide COMPLETE safety.

—to increase track capacity.

—to improve schedules.

—to protect the investment against sudden depreciation.

—to secure what is conceded to be the very best advertisement for traffic promotion.

Considering the comparatively negligible signal maintenance cost of the total operating expenses, as shown by the smaller circle, can you afford to accept anything less than complete protection?

Continuous Track Circuit Signaling is the simplest system that can be depended upon for correct signal indications under all conceivable conditions.

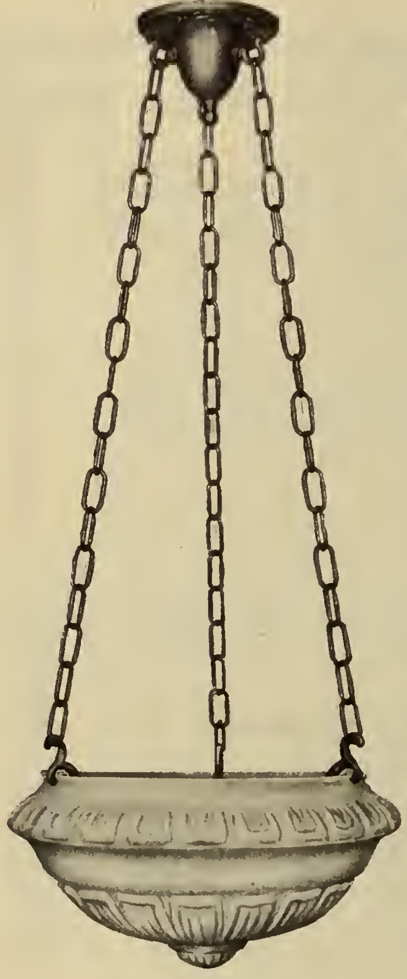
IT IS COMPLETE PROTECTION.

Without cost or obligation on your part we will outline a plan showing just what investment is necessary to secure for your road the only protection you can afford to install.

Each day's delay means a loss to your road.

GENERAL RAILWAY SIGNAL COMPANY
OF CANADA LIMITED
LACHINE, QUEBEC

9103A



No. 1025

No. 1025 complete as shown with 14 in. Knilo Bowl $15.00 less usual discounts.

We carry the largest assortment of semi-indirect Bowls and Hangers in Canada and supply hangers for any make of Bowl.

Write us for photos and prices of our line of semi-indirect and electric fixtures.

"Knight" Fixtures

Prices Right

Finish Guaranteed

Fixture Parts—Chain—Loops—Pans—Castings, etc., carried in stock at all times for immediate shipment.

We want YOUR next order.

THIS SEAL ON ELECTRIC FIXTURES STANDS FOR QUALITY—LOOK FOR IT.

MATERIAL AND WORKMANSHIP GUARANTEED. H.W. KNIGHT & BRO., TORONTO. KNIGHT LIGHT

DROP A CARD AND OUR TRAVELLER WILL CALL, GLADLY.

H. W. Knight & Bro.

TORONTO 86 Richmond St. E.

"CANADIAN BEAUTY" Electric Iron

the only Iron made in Canada which is **Guaranteed for all time.** Graceful in design and Efficient in service, it s the ideal Iron for domestic use.

"CANADIAN BEAUTY" Electric Toaster

a Beauty as regards efficiency as well as in name. An excellent mate for the famous Electric Iron.

"Canadian Beauty" Disc Stove and Coffee Percolator

a useful as well as an ornamental pair.
They are distinguished members of the "Canadian Beauty" family and carry the same high mark of quality.

Power companies and Electrical dealers write for prices and discounts to

CANADIAN BEAUTY ELECTRIC HEATING APPLIANCES

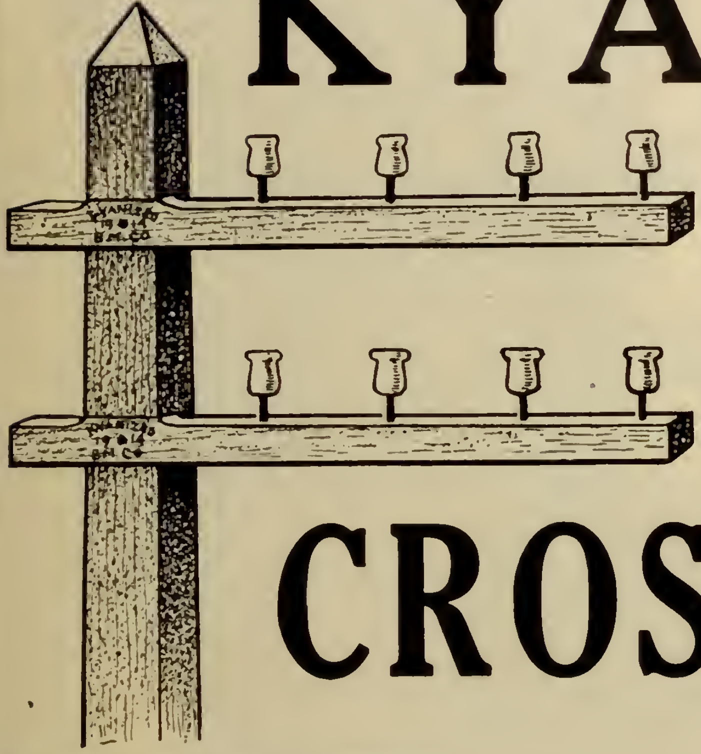
Quality — Service

Renfrew Electric Mfg. Co., Limited

RENFREW, CANADA

— B. M. CO. —

KYANIZED



Spruce

CROSS ARMS

Our selected close grained tough northern grown spruce KYANIZED to preserve it from decay makes ideal Cross Arms. You can obtain

B. M. Co. Kyanized Spruce Cross Arms

made especially for you in any type or size according to your specifications. Get our prices and let us send you our booklet "Everlasting."

Berlin Mills Company

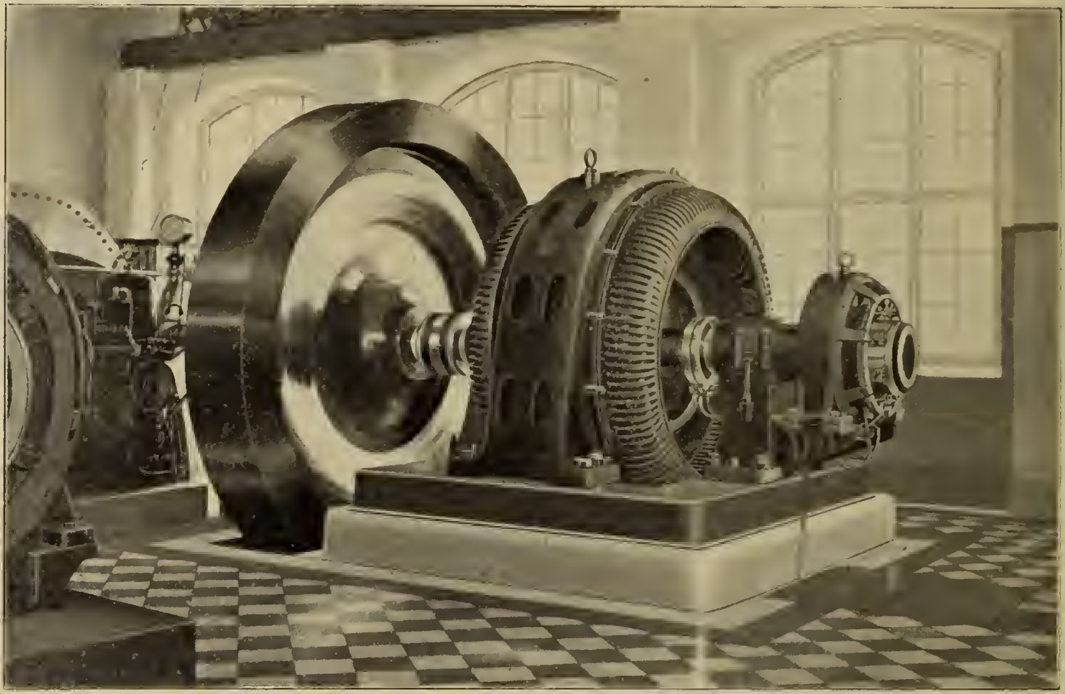
Portland, Maine

New York Office, Woolworth Building

Swedish Electrical Machinery

NOTED FOR

Efficiency and Workmanship



860 K.V.A. 3 phase, 60 cycle, 400 R.P.M., 11500 volt water wheel driven Generator with direct connected exciter.

We solicit your specifications for Electrical Equipment

BURNHAM ENGINEERING COMPANY

LIMITED

Canadian Dealers for

The Amalgamated Electric Company of Sweden

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F E A

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Moloney Quality

FOR sixteen years we have been making only transformers. All our time, study and every part of our plant is devoted to the manufacture of high efficiency transformers.

All materials used in Moloney transformers are selected for their merits. Silicon steel as used by us is the best material known for transformer cores—we proved this after a hard test extending over a year and a half.

Our catalogue contains many useful hints for users of transformers, and also describes our product fully. A card will bring it.

To Central Station Men

A special line in the manufacture of Moloney Transformers is our **Pipe Thawing Transformer**. One of these in your Central Station means a paying proposition to you. This is the season for their use. Write us at once for full particulars and prices on Moloney Pipe Thawing Transformers. They last a lifetime.

Moloney Electric Company of Canada, Limited

WINDSOR, ONTARIO

Factories at Windsor, Ont. and St. Louis, Mo., U. S. A.

901 Electric Railway Chambers, Winnipeg, Man., Can.
1001 C. P. R. Building, Toronto, Ont., Can.
401 Lake of the Woods Building, Montreal, Quebec, Can.

Complete Stocks at **Windsor, Winnipeg**

You'll Never Have Trouble With

HUBBELL Presturn Sockets

Pull Key and Keyless, all Bases

The deeds of Hubbell Sockets during their eighteen years of existence prove conclusively that Hubbell quality wins where quality begins—inside the socket shell.

There are housed the works that work as they should and must, to render substantial service.

Every Hubbell Pull Socket is regulated to the nicety of a watch. The action is smooth, firm, vigorous. Friction is reduced to the least possible degree to insure against break-downs under constant use.

To the Hubbell sturdy mechanism has been added the new Presturn Shell. It has nineteen adjusting points, each a secure locking point. Presturn Shells are simple to adjust, readily taken apart, secure under the weight of the heaviest lamp and shade. Ask for a sample Presturn Socket.

R. E. T. PRINGLE, 519 Can. Express Bldg. MONTREAL

We Purchase Outright entire issues of bonds on steam and electric railroad, gas-electric and hydro-electric properties.

N. W. HARRIS & CO.

Established 1882
Incorporated 1911

35 Federal Street, Boston, U.S.A.

Use the Railway's Trolley Poles

as the basis of your new street lighting system. You can easily convert them into attractive Mazda Lamp Standards or arc lamp supports by use of

ERECO Combination Railway Lighting Pole Fixtures

This system, besides saving you the expense of underground construction, gets the wires up out of the way of traffic, where they are practically unnoticeable and the curb line is not crowded with separate lighting standards.

The progressive railway management will gladly co-operate with you with this object in view.

Design No. 10127.

Electric Railway Equipment Co.

Cincinnati, Ohio

Designers **Manufacturers**

Canadian Representatives:

Dawson & Co., Limited, Montreal, Winnipeg

N. Y. Office, 30 Church St., Hudson Terminal Bldg.

No. 6052—18 in. diameter

No. 9070— 7 in. diameter, 4 in. Fitter
No. 9072—10 in. diameter, 5 in. Fitter
No. 9074—12 in. diameter, 6 in. Fitter
No. 9076—14 in. diameter, 9 in. Fitter
No. 9078—16 in. diameter, 10 in. Fitter

No. 4070—10 in. diameter
No. 4071—12 in. diameter
No. 4072—14 in. diameter
No, 4073—16 in. diameter
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No. 994 C 101

No. 441 C 410

MOONSTONE and Cut Lighting Glassware

is always used where Luxurious and Efficient Lighting is wanted.

The Toronto Hydro-Electric System found by test that MOONSTONE Glass gives results superior to any other glass made.

MOONSTONE Glass has been adopted for the complete Street Lighting service in Toronto and many other cities in Canada.

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No. 446—6 in. Ball C 114

Jefferson Glass Co., Limited

Toronto, Canada

I-T-E

CIRCUIT BREAKER

We do not get in on these big railway installations at first. In these ten million dollar propositions the circuit breaker is a mere detail, it goes in with the rest of the equipment for a lump sum, but notice what happens. As these stock circuit breakers begin to give out, as they will, and the Operating Engineer begins to observe their faulty operation, as he does, what happens? They are gradually replaced and invariably with I-T-E.

Make a note of the fact that no job is too big for us to tackle and no problem too difficult for us to solve. I-T-E engineering is the best engineering there is as far as circuit breakers are concerned.

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The Cutter Company, 120 Liberty Street, New York.
The Cutter Company, Monadnock Block, Chicago.
The Cutter Company, Park Building, Pittsburgh.
The Cutter Company, Traders Bank Bldg., Toronto, Canada.
The Cutter Company, Metropolitan Life Building, Minneapolis, Minn.

The Cutter Company, Telephone Building, Indianapolis.
The Cutter Company, Woodward Building, Washington, D.C.
The Cutter Company, Ford Building, Detroit.
The Cutter Company, Pabst Building, Milwaukee.
Eccles & Smith Co., Los Angeles, San Francisco, Portland, Ore.
Frank Darling & Co., Vancouver, B. C.
Electric Manufacturers Sales Company, Denver

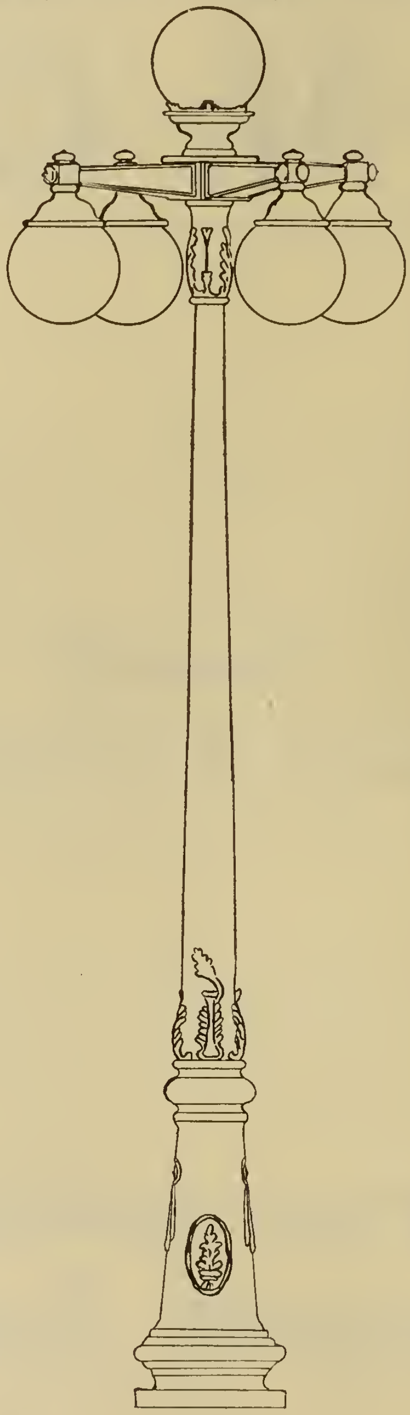
G. M. Gest

Conduit
Engineer & Contractor

Power Building,
Montreal, Canada

KING FOUNDRY CO.

Street Lighting Standards



**Artistic
and
Original
Designs**

**Durable
and
Economical**

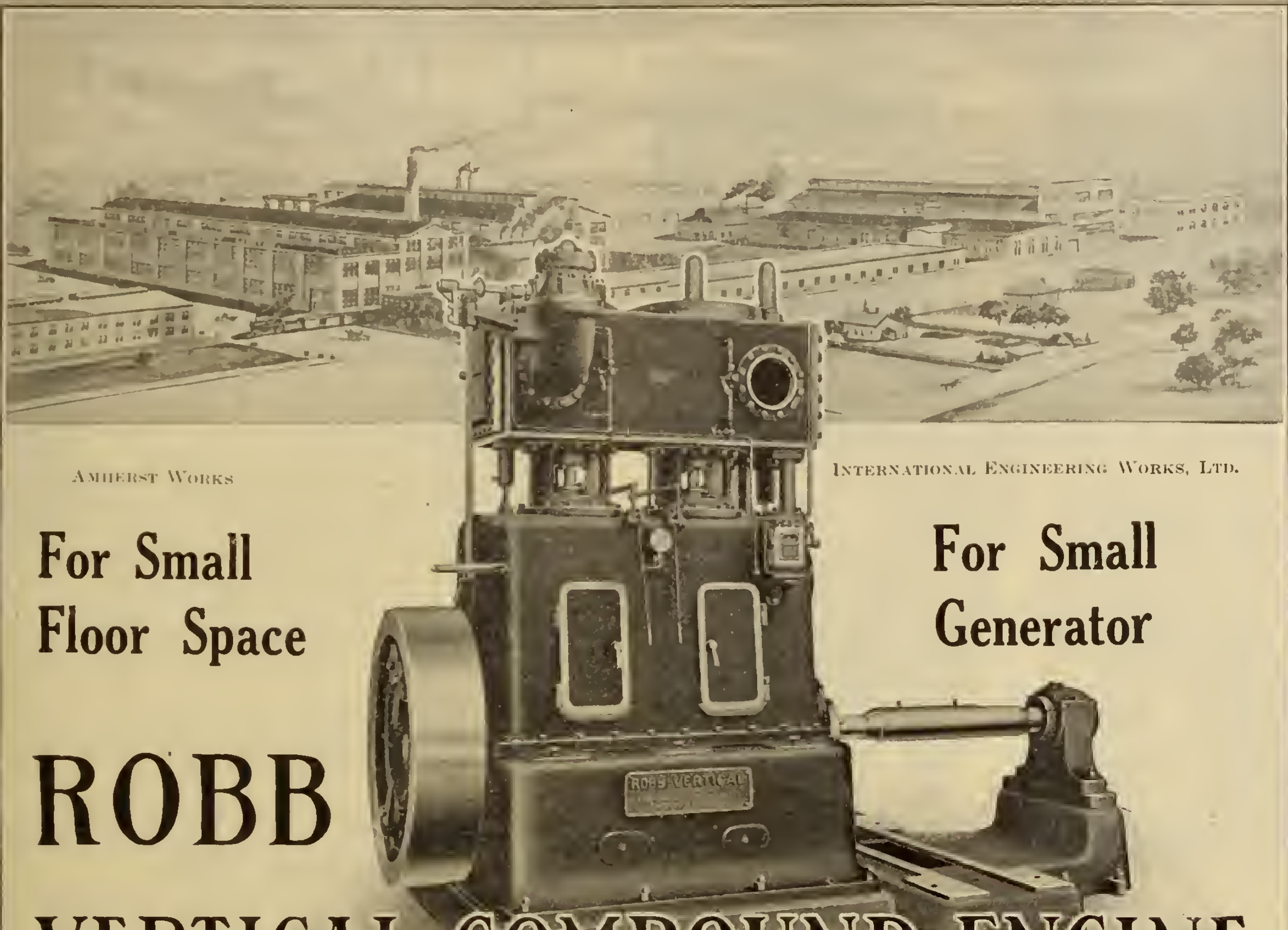
**Carefully
Constructed**

*Write us for
Descriptive
Literature*

The Mainer Electric Company, Limited

WINNIPEG, MAN. - EDMONTON, ALTA.

The Largest Electrical Supply House in the West



Amherst Works

International Engineering Works, Ltd.

For Small Floor Space

For Small Generator

ROBB

VERTICAL COMPOUND ENGINE

High Speeds of Rotation with pistons of large diameter give a powerful engine in small space. The direct-connected generator can be of small diameter because of the high speed so that the unit will be of relatively low cost and small dimensions for a given kilowatt output.

Quiet and satisfactory operation at piston speeds of only 500 to 800 feet per minute make these engines particularly adapted to electric light plants and electric railway service—installations requiring high-grade durable engines which will operate under a great range of load.

Long periods of operation without attention are made possible by the system of forced lubrication which supplies all bearings with an abundance of oil.

Complete enclosure of all moving parts prevents oil from flying about and protects the parts from accidental injury.

Low Steam Consumption is due to the very small clearances, high speed, automatic governing, and refinement in finish.

Ask for Bulletin No. 201.

INTERNATIONAL
ENGINEERING WORKS, LIMITED

SO. FRAMINGHAM, MASS. AMHERST, N.S.

Montreal Winnipeg Edmonton Toronto Vancouver Calgary

39-70

A Demand

The demand for a light, portable vacuum cleaner, inexpensive to buy and operate, has been filled by the

EUREKA
Vacuum Cleaner

This electrically operated cleaner will sell to most customers on demonstration. The machine and tools are made of aluminum. The motor is specially made for the purpose, in our own factory and is absolutely guaranteed. The fan is made of steel so that matches or other articles passing through cannot injure it. A brush which takes up lint, hair, etc., is furnished free with every machine.

WRITE FOR CIRCULAR AND DEALERS' PROPOSITION

ONWARD MFG. CO.
BERLIN, ONT.

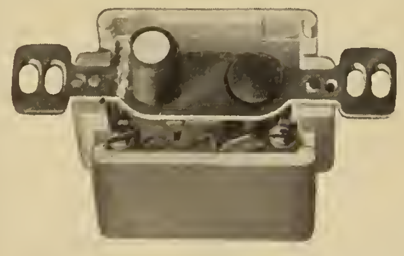
SAFETY FIRST
This is Assured by Using
Monarch Specialties

Push Button Flush Switches

Single Pole, Double Pole, Three Way
With or without Brass Plates
Design and Construction Guarantees Durability, Accuracy in Operation.

Pull Chain Sockets

Supplied in Polish Brass, Brush Brass, Nickel Plate and Oxidize Copper Finish, From Stock, Other Finishes to Order.



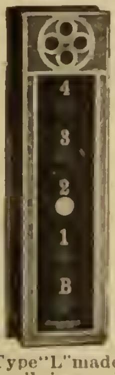
If your Jobber does not stock Monarch Specialties write direct.

Monarch Electric Company, Limited
District of Montreal ST. LAMBERT, P.Q.

Representatives Wanted

Here is a splendid opportunity to handle these tried and tested instruments in your section. For 20 years we've specialized on this class of work and today "Connecticut" instruments are justly famous for their high quality and reasonable prices.

Be the dealer in your section to handle this profitable line. Write for particulars today.



Type "L" made in all sizes and styles.

CONNECTICUT

Electric Reset Annunciators and Interior Telephones

"Connecticut" Annunciators and "Connecticut" Interior Telephones have many advantages found in no other make. They appeal to the user because they are simple in construction, effective in action, look good, wear well and give lasting service.

No. 52 A

They are made in a wide variety of styles and sizes—each style suited to its particular requirement. You're selling satisfaction—making lasting customers—when you sell "Connecticut" goods.

Write for Catalog 22 C and Full Details

Ask us for particulars of our proposition for representatives. Look over our Catalog and note the completeness, reasonable prices and high quality of the "Connecticut" line.

Connecticut Telephone & Electric Company, Inc.
Meriden, Conn., U. S. A.

What's in a name ?

"LE CARBONE"

(Made in France)

Carbon Brushes

Means :
- **Lowest yearly** brush **cost.**
- Increased car mileage.
- Practically no commutator wear.
- Armature room **expense reduced.**
- Perfect uniformity of efiiciency.

Le Carbone Brushes quality never varies !

Rougier Freres Inc.

63 Notre Dame, East
MONTREAL, P.Q.

Tallman Fixtures

They're Different

Tallman's

Reputation is in the Goods.

Tallman Brass & Metal Co.
HAMILTON, ONT.

Electrical Decorative and Equipment Company

70 Lombard St. - Toronto, Ont.
Long distant phone Main 3634

Electrical and Flag Decorators and Designers

WE sell or rent all kinds of Electrical Signs, streamers of lights and other spectacular Electrical effects. We make a specialty of High Class Decorations for Street Fairs, Carnivals, Celebrations, Centennials, Old Home Weeks Street, Conventions, Conclaves, Parks, Buildings, Auto Shows, Balls, Fairs, Dances, Banquets, Industrial Expositions, Food Shows, Christmas and New Years, etc.

Our decorations are elaborate, appropriate and refined. We carry a complete line of Electrical Set Pieces, Signs, Streamers of Lights and Bunting for all Lodges, Orders and all occasions. Get our prices and designs for your occasion.

GEORGE ELLISON

Manufacturing Electrical Engineer.

SPECIALTIES

Prompt Delivery of

Air and Oil break full automatic,—
- A.C. & D.C. Circuit Breakers
- Auto-Transformer Starters
- Star-delta Starters

All details for Crane control,—
- Relay Type Crane Panels
- Drum Type Controllers A.C. & D.C.
- Brake Solenoids. Limit Switches

Adjustable Time Lags

Responsible representatives required for the Dominion

Address G. E. ETLINGER

c/o Canadian Express Co. MONTREAL

STEEL PIPES

Seamless or lapwelded, mild steel, 2″ in diameter and up, long lengths.

“ INDUSTRY ” Bell and Spigot steel pipes for water or gas.

These pipes are asphalt coated inside and out, wrapped with specially prepared Jute, insuring protection against corrosion, and long life.

SPECIALS for “ INDUSTRY ” pipes either of steel or cast iron.

HIGH PRESSURE steel pipes for PENSTOCKS, FLUMES, NATURAL GAS, AIR or OIL.

All pipes tested by hydraulic pressure before shipment from the works.

Manufactured by the **GELSENKIRCHEN MINING and STEEL CO., GERMANY,**— One of the largest steel plants in Germany—employing 50,000 men.

Canadian Sales Agents

STEFFENS & NOLLE, Limited

137 McGill Street, Montreal

Boiler Tubes, Superheater and Stay Tubes

TURBO-PUMPS

FOR ALL KINDS OF SERVICE
ANY CAPACITY OR PRESSURE

Highest
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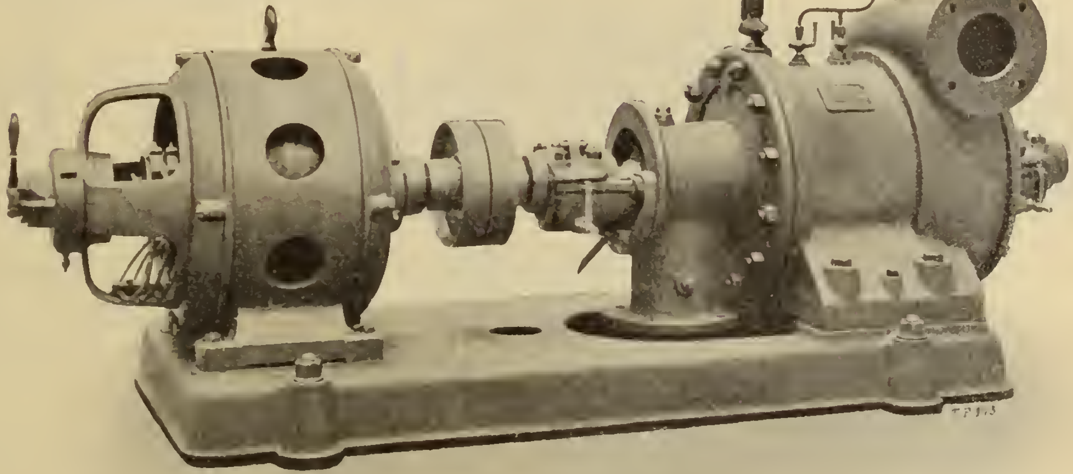

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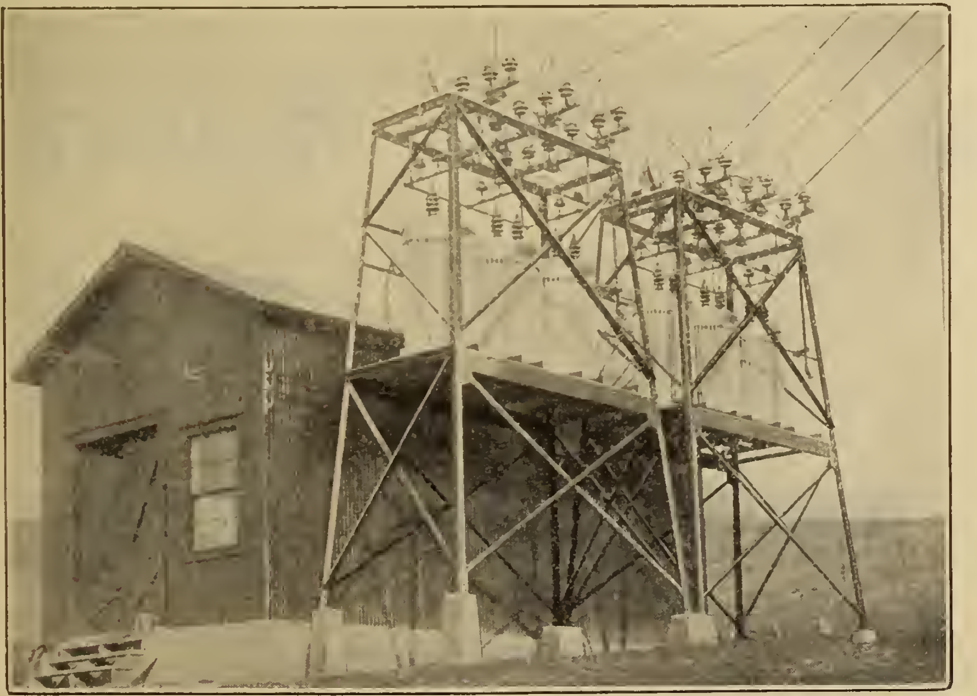

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Many thousands of "Eclipse" Irons are in use all over the world, in the home, in Laundries, Dye Works, Lace and Linen Factories, etc., where they are giving unqualified satisfaction.

Can be obtained in Canada from the Supply Authorities, Electrical Dealers, or from our Montreal Office.

The Electric & Ordnance Accessories Company, Limited
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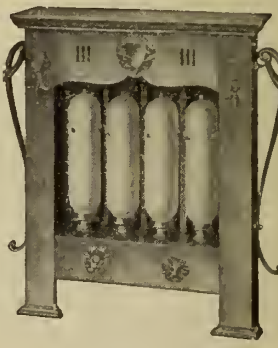

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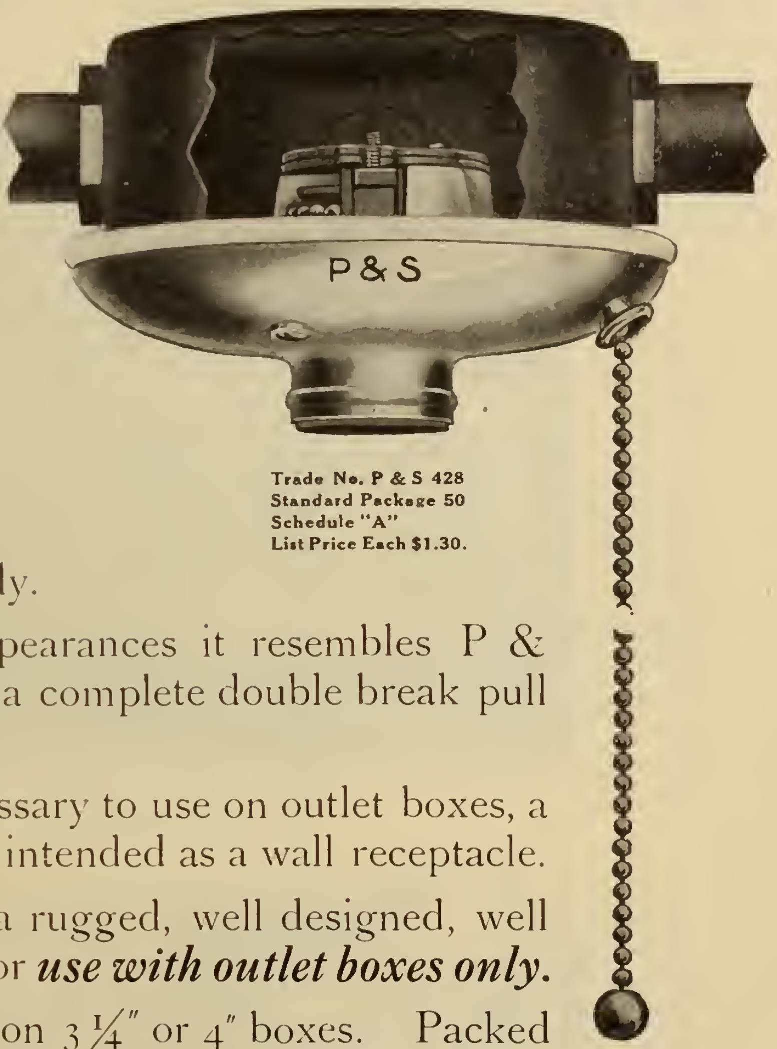

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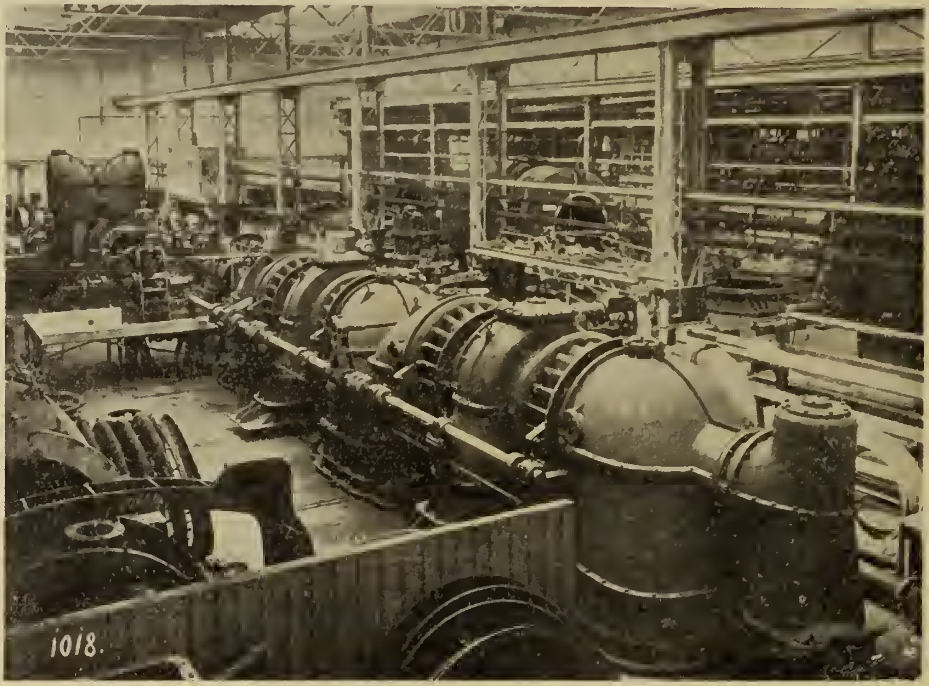

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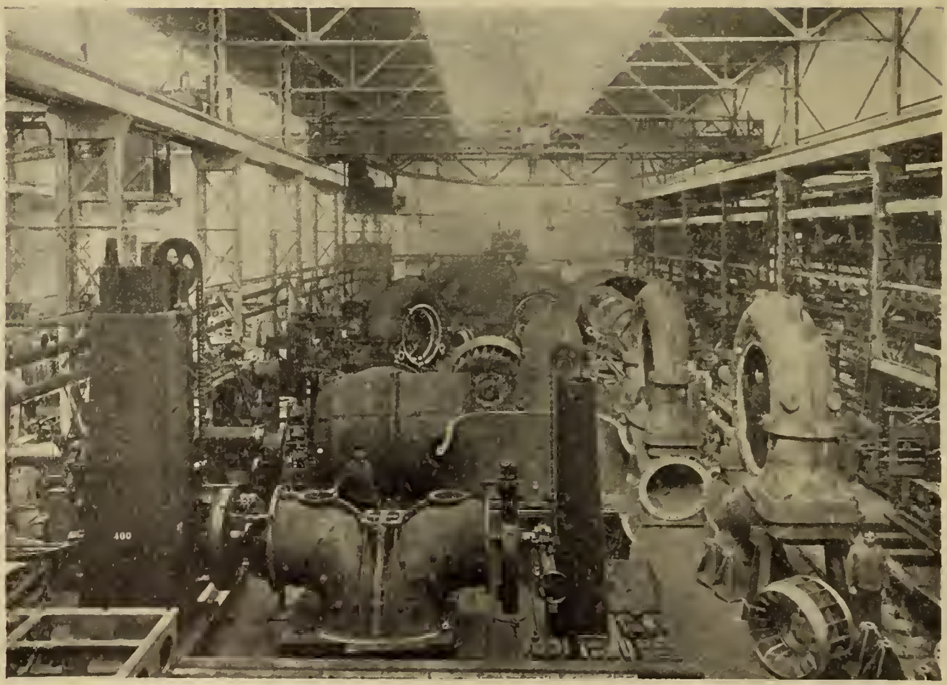

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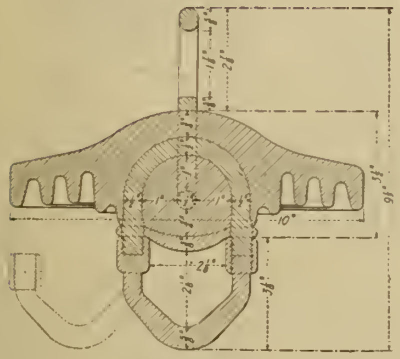

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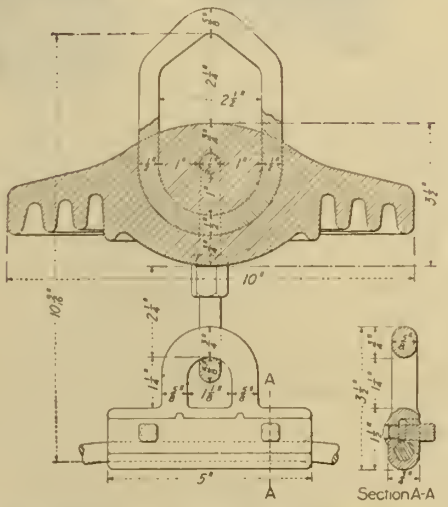

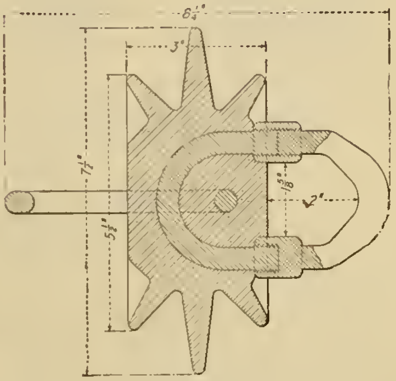

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7. The most perfect disk form of design combined with highest efficiency and light weight.

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10-inch Suspension Line and Strain Insulator

Puncture Value	150,000 volts
Dry Arc	100,000 "
Tested to Dry Arc	100,000 "
Rain Arc	55,000 "
Line Voltage	25,000 "
Weight	11 lbs.

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7 1-2 Inch Disk Strain Insulator

Puncture Value	120,000 volts
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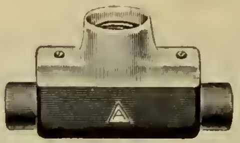

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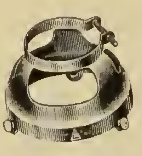

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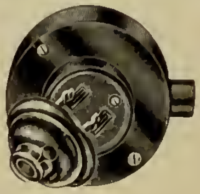

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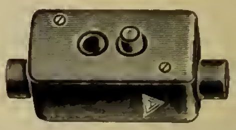

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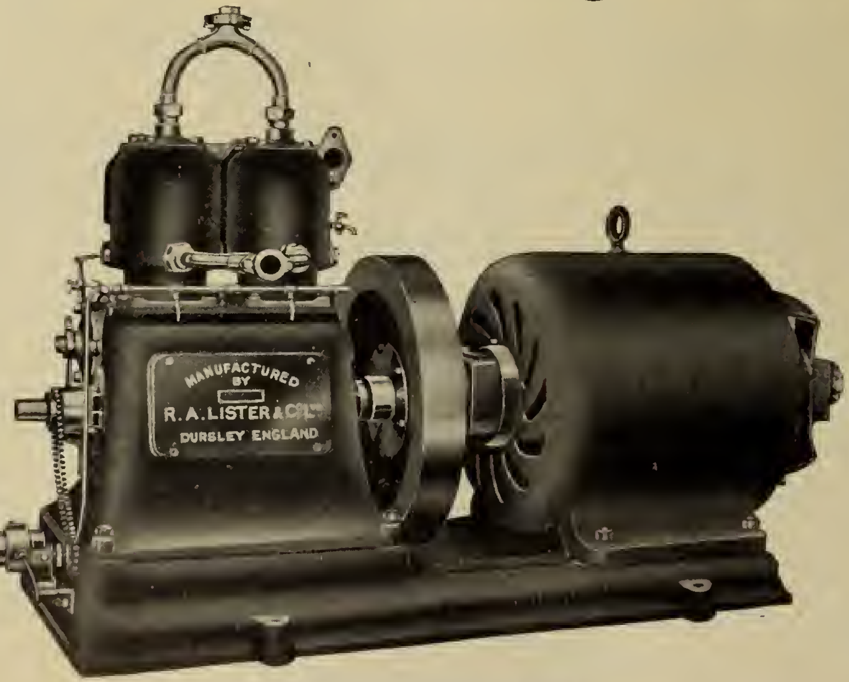

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Complete stocks at each of our houses insures quick delivery to you.

Make a contract now for your season's supply. We will help you sell them. Literature, newspaper advertisements and window displays will be sent on request.

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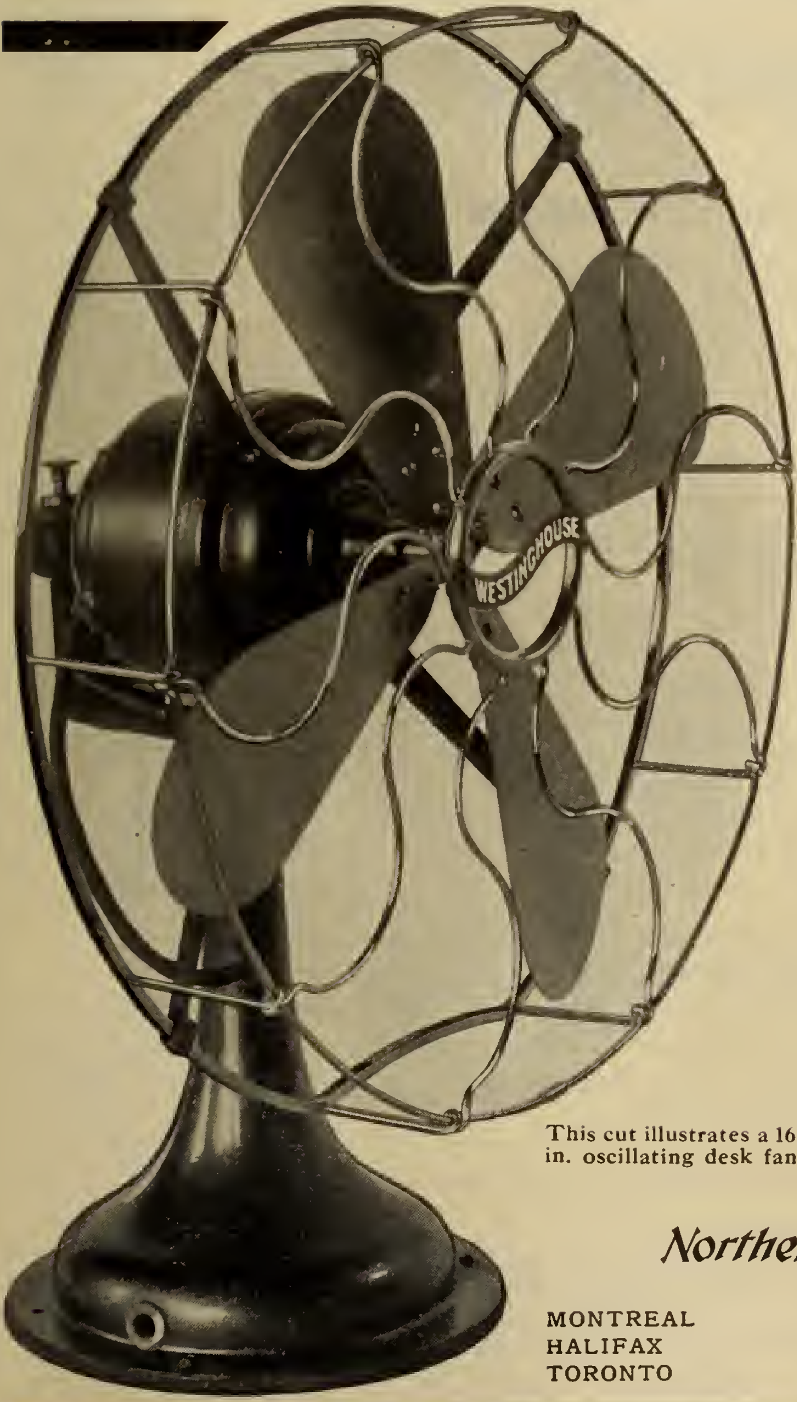

This cut illustrates a 16-in. oscillating desk fan.

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APPROACHING FAN SEASON

Avoid the troubles you had last season

Don't take chances this year in having your fan orders delayed and then coming along to you when the season is half over. Make sure of your order **early**—make sure of it **right now.** Send in for our **"Special Future Delivery"** contract form. It insures the delivery of your fan order in plenty of time for the beginning of the fan season.

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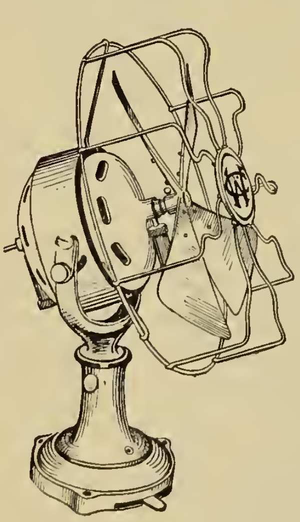
The MARK of **QUALITY**



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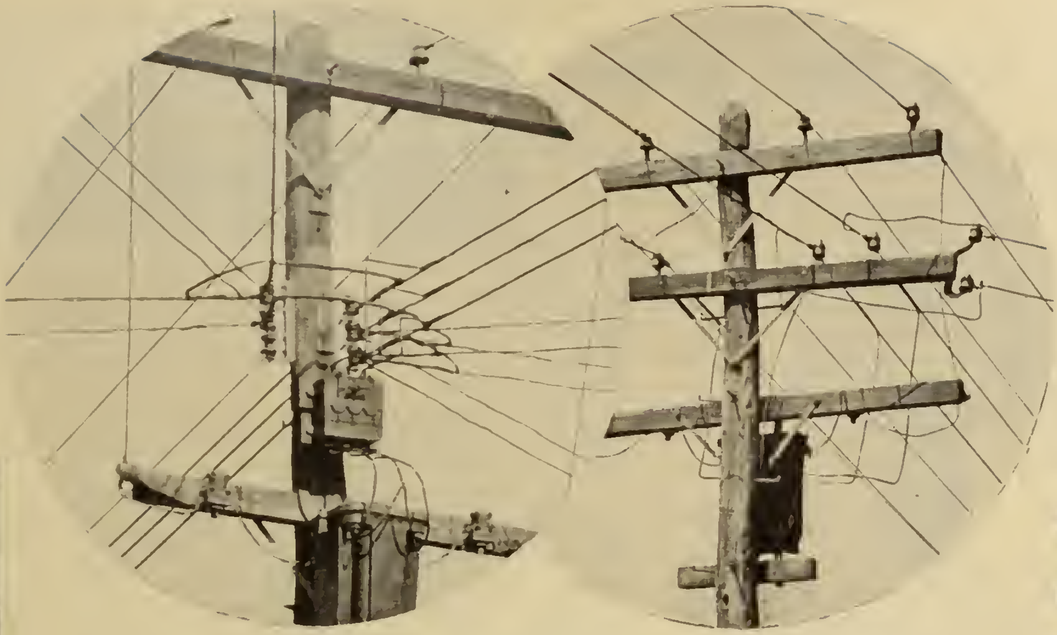

The Old Horizontal System of Distribution

is Due for a Total Eclipse

It involves expensive, unsatisfactory crossing of wires and heavy up-keep expense. It crowds the pole with only a few service connections, and it looks ragged. If you want to save first cost and maintenance cost, adopt

Vertical Distribution with Peirce Secondary Racks

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The Hardware MAKES the Line
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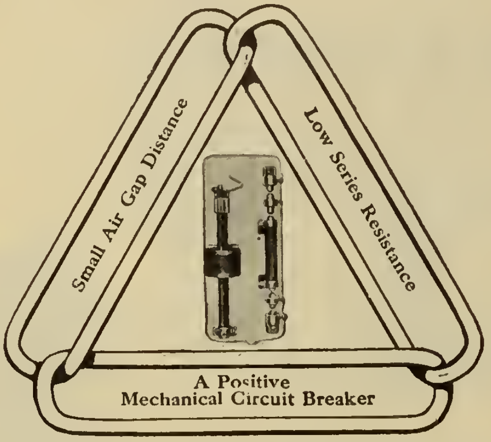
You Get The Three Vital Functions and a "Guarantee" When You Buy Garton-Daniels.



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A small air gap distance that will break down and discharge lightning or excessive voltages before they reach values high enough to puncture the windings of your apparatus. Small air gap distance means efficient protection.

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Garton-Daniels Lightning Arresters are the only lightning arresters combining every necessary function of a complete lightning arrester. Furthermore every A. C. type is unconditionally guaranteed for one year.

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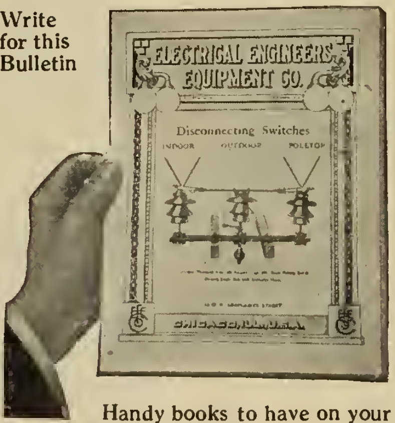

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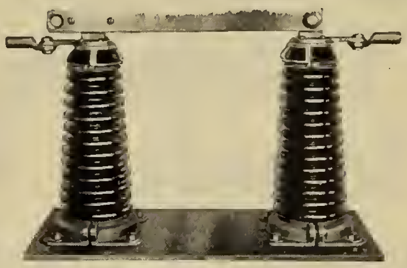

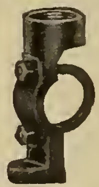

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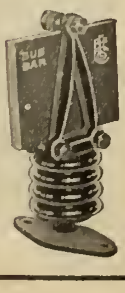

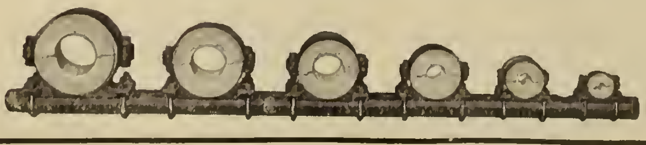

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Electrical News
Generation, Transmission and Application of Electricity

Published Semi-Monthly By
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Subscribers are requested to promptly notify the publishers of failure or delay in delivery of paper.

Vol. 23 Toronto, April 15, 1914 No. 8

The Vindication of Ontario's Hydro-Electric System

It is neither the province nor the policy of the Electrical News to boost any system or any type of electrical management at the expense of the others. We aim always and only to state the facts insofar as our knowledge and judgment teaches us, having in mind the general advantage of the electrical industry in Canada in its many varied phases. In this issue we have taken occasion to describe the operations of Ontario's municipal system during some three and a half years of active work. Fortunately the facts in our possession enable us to write freely and in a congratulatory strain. The present issue, however, is not intended in any sense as a defence of the system as we believe that all doubts and attacks have been best answered by the results. The commercial results are better, much better, than were originally hoped for. The costs of installation have been kept well within the estimates. The scope of the Commission's work is getting broader, with increased usefulness, each year. It can also be said, we believe, that politics has been made to play a subsidiary part. Of course the hands of the government have been strengthened by the success of their hydro scheme but that could not well be otherwise. They would have been correspondingly weakened by its failure. So far as we can judge there is no sign of diminished enthusiasm among the municipalities who are being served or those who hope soon to be supplied with electrical energy. There is no apparent sign that, except in a few diminutive cases, any insurmountable difficulty is being experienced in financing the various parts of the system. In short, there is no sign of bankruptcy at any part of Ontario.

In saying so much we do not wish to be understood as seeing eye to eye with the Commission in all that might have been done or that might be done in the future. We have frequently expressed ourselves as unalterably in favor of giving a square deal alike to municipality and private company. We believe that every possible care should be taken to shut out even the most remote sign of political interference. In as much as the credit of the whole province is behind the scheme every citizen of the province should have the same just consideration. In the main we believe the course pursued by the Commission has been fair and judicious and this presumably will become easier as the success of the work becomes more and more assured. The golden rule is as applicable here however as to any other phase of our daily life and the Commission will add to its usefulness in proportion as it wins the co-operation of the naturally antagonistic section of Ontario to this municipal undertaking.

Toronto's Annual Report

The annual report of the Toronto Hydro-electric Department as just made public indicates that the progress of the system for the past year has been very satisfactory. The number of meters in use, which presumably represents the number of customers, increased during the year by 80 per cent. and the peak load increased by 31 per cent.

The total expenditure to date is represented by an amount of $4,698,234, a figure somewhat out of proportion to the original estimated cost of this system though it must of course be taken into consideration that additions and extensions in excess of the original plans are very considerable and that lines have been built both for power and lighting service which will in all probability meet the requirements of the city for some years to come.

The net surplus has not been deemed sufficient to justify the Commission in giving the citizens of Toronto any lower rate than they now enjoy. A study of the report would seem to indicate that the Commission are acting very wisely in this matter. The financial aspect has been considerably changed during the last twelve months by the unsatisfactory sale of a quantity of debentures which has placed the system under the necessity of making good some half million dollars for which they receive no value. It would have been possible to cover this amount by the issue of further debentures but the commissioners have deemed it the proper course to assume the obligation just the same as if they had actually received the cash, and debit the necessary carrying charges against earnings.

It is a question open to discussion possibly whether it might not have been right to charge this against the city as a whole. If the city council undertakes to finance hydro matters and then bungles them as in the recent instance it seems reasonable that they should take the responsibility. The Commission, we believe, should be given authority to handle these matters themselves.

Looking to the future, the report states that it has been determined to install an auxiliary steam plant at an approximate cost of $1,000,000. The carrying charges on this will have to be taken care of though there will be no appreciable increase in revenue as a result of this expenditure. It would certainly appear to be the wisest course, therefore, to make quite certain that the revenue of 1914 represents a sufficient increase over the past year to take care of these added charges, before any reduction is made in the rates.

The tone of the report would seem almost to be suggestive of the vindictive at times. It is not easily understood what can be gained by giving further prominence to certain domestic matters that have long since been relegated to ancient history. The alleged mismanagement is not, even in the report, held to be responsible for the financial condition of the system. It is not easy to understand either why the Commission assume no responsibility for the mismanagement of a business with the innermost workings of which they are supposed to be intimately in touch though in almost the same sentence they tacitly take credit to themselves in speaking of their new appointment and the efficiency of his work to date. Either their expressions of approval are to be taken with the proverbial grain or the public is to understand that they are now better seized of the managerial situation. Knowing the local conditions as well as we do we have no doubt that the Commission's expressions of confidence in the present manager are amply justified but the report is printed presumably for wide distribution and inference might be drawn.

Evidently the Commission is cramped for want of working capital. This is poor business, and the council should either see that the necessary funds are forthcoming or invest the Commission with power to provide their own capital. The latter we believe to be the better way.

Safety First

The Montreal Tramways Company have organized a very comprehensive Safety First movement, which is designed to influence every man, woman and child in the city. The prevention of accidents has, in one sense, an economical end in view as far as the company are concerned, but the thoroughness with which the plan has been laid out is evidence that the directors are also anxious that the public should be guarded from accidents of all classes. Mr. G. A. Gaboury, the superintendent of the company, who is primarily responsible for the movement, explains that no question of cost will be allowed to stand in the way of a complete educational scheme, and that it is intended to persistently instil into the public mind the idea of Safety First, so that an attitude of caution will become second nature to the people.

The first step in this campaign is the sending out of personal letters; then arrangements will be made to show moving pictures bearing on the prevention of accidents, these being exhibited to tramways employees in the club quarters and to the public in the ordinary theatres. Special exhibitions are to be arranged for children, who will be admitted free on passes supplied to the schools by the company. The children will be presented with little ticket purses and other novelties bearing the words "Safety First"; also blotters, rulers, scribblers, etc., with illustrations of how accidents are caused by carelessness.

The company will ask the co-operation of owners of every class of vehicle in showing signs; pictorial posters are to be displayed on the hoardings; large calendars, with illustrations of how accidents can be avoided, will be distributed to the schools, colleges, garages, stables, and offices; and letters are to be written to the thousands of auto, cab, express and wagon owners and drivers, emphasizing the importance of this educational campaign. Each letter will contain, besides, a personal letter to the recipient, circular pamphlets setting forth the dangers that attend traffic on the streets of the city where street cars operate, the dangers of greasy or wet rails, the possibility of brakes refusing to work or a car getting beyond control, and a hundred and one other eventualities that might occur to cause an accident, all of which may be avoided by waiting till the car has stopped before crossing the street either in front or behind it.

Besides this, "Safety First" signs will be placed on every street car, every trolley sign pole, every article of the company's property; and every transfer, letterhead, notices and stationery in general used by the company will bear the words prominently displayed.

Weekly meetings for employees of the company will be held, at which Mr. Gaboury will give short lectures on how to prevent accidents; instruction, drill and competitions for the men in accident preventive measures will be instituted; branches of the St. John's Ambulance Society will be established, and each of the men provided with small badges bearing the words in English and French, "Safety First," and "Prenez Garde." Extracts of the letters to drivers and chauffers will be sent to the street car men, in addition to the special instruction given them, so they may know what all are asked to do, and the motormen and conductors are cautioned to be as considerate towards vehicular and pedestrian traffic as they expect the latter to be towards themselves.

This plan is to be systematically developed and carried out, so as to thoroughly impress the public mind, and to prevent accidents which are a loss to all concerned.

Engineering Personals

The firm of Kerry & Chace, Limited, have lately made arrangements whereby Messrs. Arthur L. Mudge and A. Leo. Mieville have become associated with them as managers of the electrical and mechanical branches respectively.

Mr. Mudge for over four years was chief electrical engineer for the Toronto office of Messrs. Smith, Kerry & Chace during the period in which they had charge of the design and construction of hydro-electric plants and long distance transmissions for a number of companies, including,—the Electric Power Company, Limited, for whom six hydro-electric plants and one Diesel oil engine plant were constructed in Eastern Ontario; Calgary Power Company, Limited, Calgary, Alta., and Mines Power Limited, Cobalt, Ontario. For the past year Mr. Mudge has been chief engineer of the Midland Construction Company, which carried out most of the construction work for the Electric Power Company. With his present connection he is prepared to undertake consulting electrical engineering work including reports, valuations, designs, supervision of construction, and advice generally with reference to all matters in connection with hydro-electric developments, power transmission, local distribution systems, street lighting, power contracts, and industrial applications of electric power.

Mr. Mudge has taken an active interest in and has done faithful and energetic work for several of the technical societies having served for several years on the executive of the Toronto Section of the American Institute of Electrical Engineers, of which he was Chairman for a year. He is first vice-president of the Canadian Electrical Association and is engaged actively at the present time in adding to and improving the library of the Toronto Branch of the Canadian Society of Civil Engineers.

Mr. Mieville was at one time designer of high speed machinery for Allens of Bedford, England, a firm for whom he until recently acted as engineer in Canada, putting in several steam and hydraulic installations throughout the country. Previous to this, Mr. Mieville had acted as assistant engineer in the construction of the City of Winnipeg hydro-electric development and as turbine designer with the I. P. Morris Company of Philadelphia.

Before leaving England Mr. Mieville had been, for several years, engaged upon paper mill engineering and latterly in marine work, being occupied for a long time in designing engines, turbines and general machinery for torpedo boats, destroyers and other craft for British and foreign admiralties. This long experience in steam and hydraulic work should prove invaluable to the firm of Kerry & Chace, Limited, in building up their mechanical branch. Mr. Mieville is in a position to solve power and pumping problems in the light of the best modern practice and will undertake consulting work in these branches of engineering.

Hydro-Electric Operations in the Province of Ontario

A detailed description of the Engineering extensions and commercial operations of the system of the Ontario Hydro-Electric Power Commission since its inception some three and a half years ago.

Of interest to Manufacturers, Dealers, Engineers, Contractors, Operators and to every citizen of Canada irrespective of his calling.

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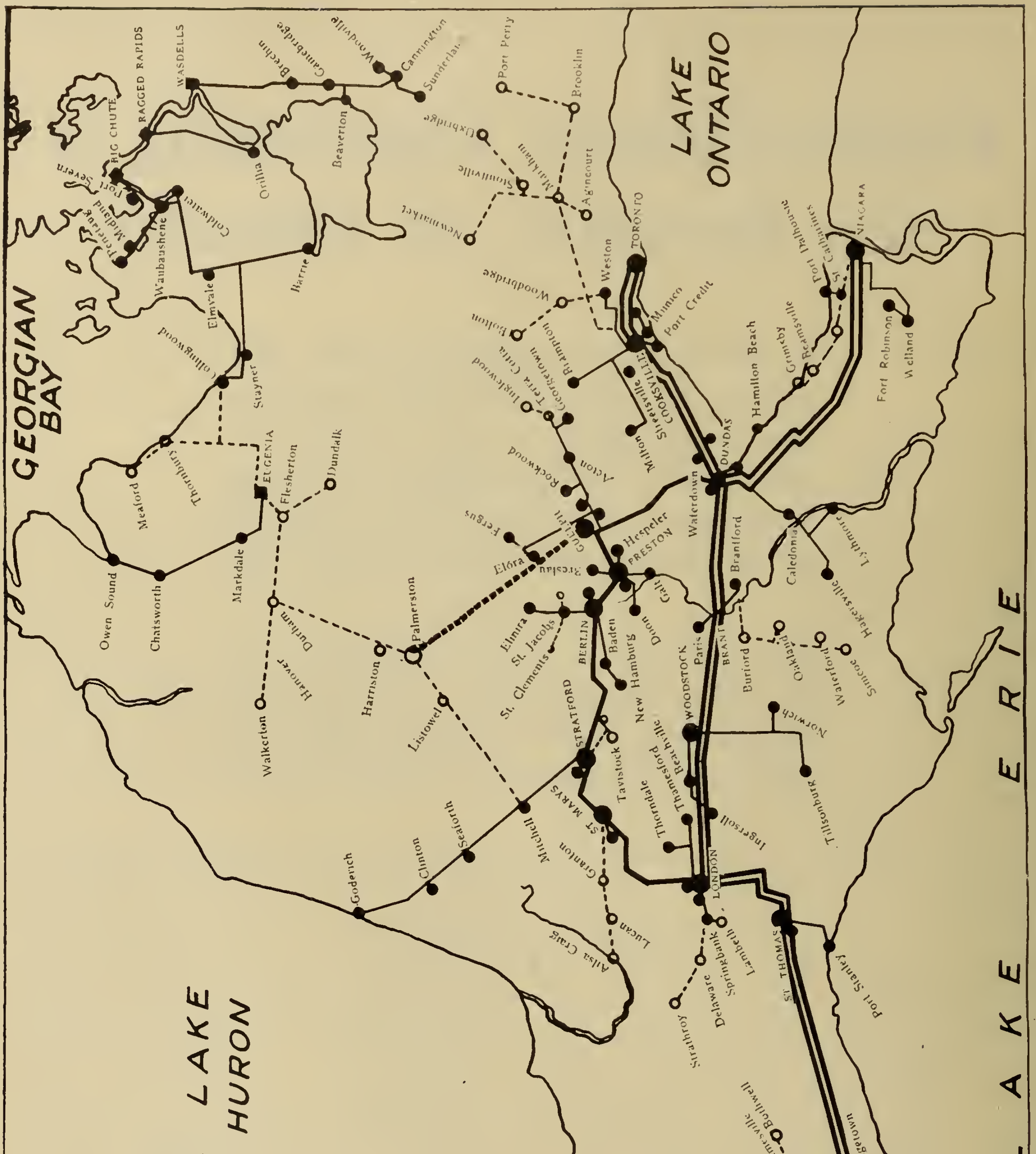


Fig. 1.—Map showing the extent of the area served by the distribution systems of the Ontario Power Commission from Niagara Falls, Severn River and Eugenia Falls.

Brief Retrospect to Previous Hydro Issue

The first stage in the scheme of hydro-electric development and distribution as being carried out by the Hydro-electric Power Commission of Ontario was described in the November, 1910, issue of the Electrical News. The work to that date had been almost entirely of an engineering character. The details had been worked out with minute and skilful consideration taking cognizance of all available experience and technical information known to the Commission's engineers. There was only lacking the proof that the great scheme was a commercially reasonable proposition.

The second stage of the Commission's work has been the turning of this system to practical and commercial account. It has been the work of the last three and a half years to prove to the world that the greatest undertaking of its kind is none the less a success because it is controlled by a people's government and operated for the direct benefit of the people who own it. From one end of Ontario to the other the judgments of the promoters of this great municipal hydro-electric movement have been confirmed. So that to-day Ontario boasts an enterprise which is universally recognized as commercially sound and as having benefitted very large areas and very large populations in different sections of the province without adding any load to the taxpayer. Nor does it show any signs of continuing anything but a source of education, pleasure, commercial development and financial advantage.

It is the history of this system from November, 1910, to April 15, 1914, that the present issue of the Electrical News will endeavor to describe in as much detail as the limited space at our disposal will allow.

Before proceeding with a description of the more recent work it will be well to review the situation briefly up to 1910 as described in our former hydro number. It will be recalled that a contract was closed with the Ontario Power Company for a supply of the necessary power up to 100,000 h.p. At date November, 1910, the power house of this company contained seven units with the eighth being installed. The generating voltage is 12,000, current being transmitted by underground cable to the step-up transforming station of the Commission located on the hill top, just at the rear of the generating plant. In this station the voltage is raised to 110,000 volts for transmission.

The transmission system up to the end of 1910 included a double circuit steel tower line from Niagara Falls to Dundas, from Dundas to Toronto, from Dundas to Guelph and west through Preston and Berlin to Stratford. The loop had also been completed by a double circuit tower line connecting Dundas with London directly through Woodstock, and continuing south to St. Thomas. Between Stratford and London a single circuit tower line only had been built. On these towers both circuits had been strung only from Niagara to Dundas and Dundas to Toronto. On the remainder of the towers only one circuit was yet installed.

Transforming stations, stepping down from 110,000 volts to either 13,200 or 6,600 had been built and equipped at each of the above-named points and distribution had been accomplished to some twenty-one municipalities. At the end of 1910 the total power load of all these municipalities had not reached 5,000 h.p., the system having been in operation only a few weeks before the close of that year.

Our former issue outlined in considerable detail the engineering features of the various sub-stations, to which was added information of a local nature describing the methods of installation of distribution systems both underground and overhead in a number of municipalities which were typical of the whole system. Wiring diagrams, showing the layout of the high and low tension equipment were given of all the high tension distributing stations. One of the most interesting reproductions was the first load curve of electric power supplied by the Hydro-electric Power Commission of Ontario which was made in Berlin on September 28, 1910.

Abundant evidence of the growth of Ontario's municipal enterprise is found in the fact that the original twenty-one municipalities have grown to sixty-seven; the load of 5,000 h.p. has increased to approximately ten times that amount; nearly 600 miles of wooden pole lines have been built (this not including the work undertaken by the municipalities themselves); 103 miles more of 110,000 volt, steel tower transmission lines have been constructed; between 300 and 400 miles of 110,000 volt cable has been strung on the original towers. Welland is being reached by a 46,000 volt steel tower line. Operations have been extended to Port Arthur, Ottawa, Severn River and Morrisburg districts, in addition to much other work of which we shall speak in more detail in the pages that follow.

At the time the original equipment was installed at Niagara and in the various sub-stations throughout south-western Ontario it was

Mr. F. A. Gaby, Chief Engineer of the Ontario Commission.

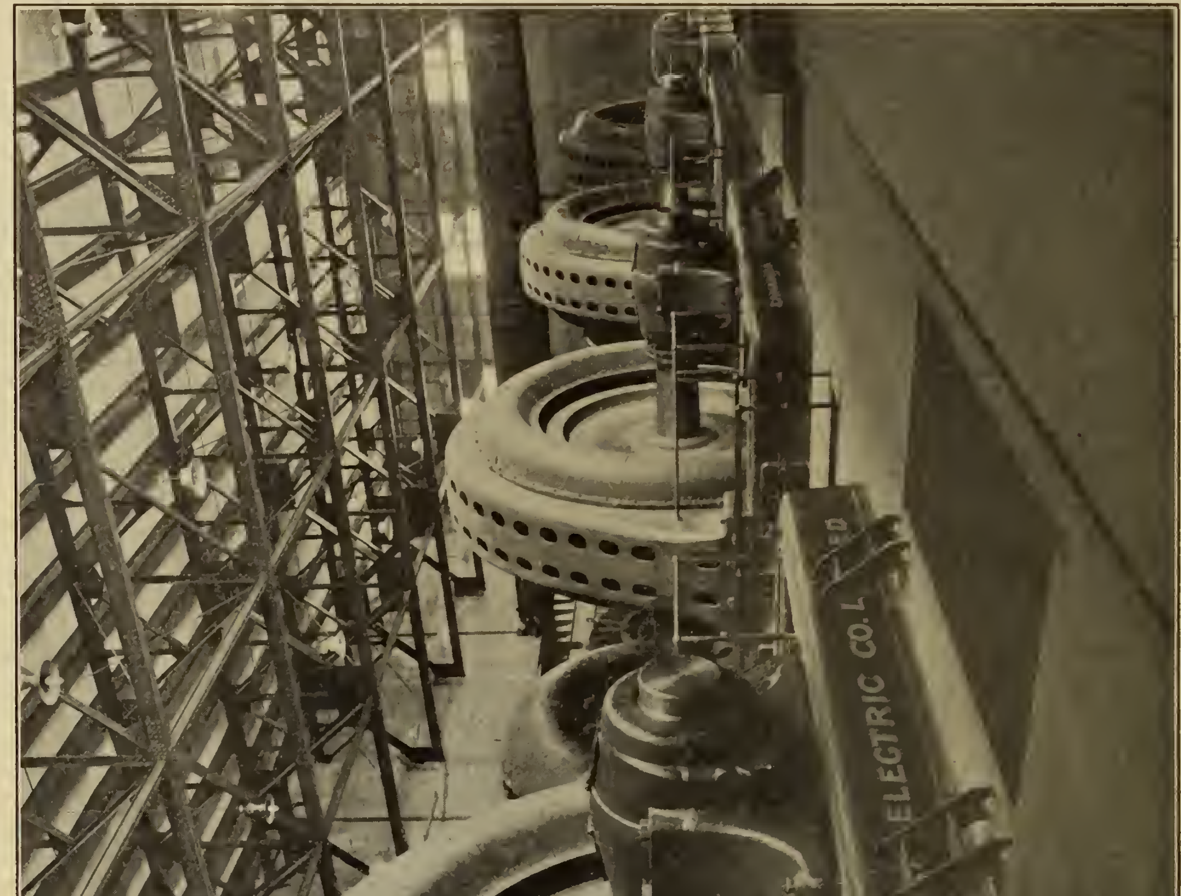


Fig. 2. Units 11, 12, 13, 14, Ontario Power Company, Niagara Falls. The last of these has just been installed. All were supplied by the Canadian General Electric Company. They are 8,776 kv.a. normal rating, 12,000 volts, 187½ r.p.m., 25 cycles.

believed that sufficient capacity had been installed to supply the demands for some years to come. The tremendous extensions and additions of the past three years and a half, however, have, as already indicated, been beyond the most sanguine expectations of the most enthusiastic supporter of the Commission's work and no better proof is required of the success, both engineering and commercial, of this enterprise than the big additions that have been necessary at nearly every point of the system.

In the generating station of the Ontario Power Company the eight generators have been increased to fourteen, largely as a result of the increased demands of the Ontario Commission.

The Niagara sub-station, which originally contained nine 3,000 kv.a. single-phase transformers now has a capacity of 73,000 kv.a. This is, of course, the result of increased requirements all over the system and it is gratifying to note that pressure of demand has necessitated increasing the capacity of a number of the original high tension transforming stations. For example, Toronto's original equipment of 7,500 kv.a. has been increased to 25,000; Berlin from 3,000 to 4,500 kv.a.; Preston from 3,000 to 4,500 kv.a., etc. In addition new high tension stations have been added to the Niagara system aggregating 25,000 kw., until the total transforming capacity in the various distribution stations on the Niagara system (controlled directly by the Commission) including the Niagara station itself is over 170,000 kv.a. Exclusive of the Niagara station the total is 96,500 kv.a.

In the operations which have been extended to the Severn River (Big Chute) district there is now an installed capacity of 2,800 kv.a. distributed to half a dozen towns. In the Port Arthur system there is an installed capacity of over 5,000 kv.a.; at Wasdell's Falls of approximately 1,000 kv.a.; at Prescott of approximately 450 kv.a. The Commission have also been instrumental in the organization of a municipal distribution system in Ottawa where power is purchased from a private generating company. The construction of hydro-electric radial lines at various points in Ontario has also received much consideration at the hands of the Commission and their engineers and it looks as if construction work would be commenced at an early date. In addition to all this a campaign of education has been carried on vigorously throughout the rural districts showing the value of electric power and its possibilities in farm work. Much success has been met in this respect and the future is promising.

The foregoing brief review will give the reader a general idea of the situation at the end of 1910 with the general progress made in the mean time.

As already stated the work may be considered as having divided itself into two stages, the first, the engineering stage; the second, the commercial stage. The general review which follows will be considered under these two headings with an added reference to the hydro-radial system. as at present outlined, and one or two other departments of the Commission's operations.

Throughout this work the personnel of the Ontario Commission has remained the same, namely, Hon. Adam Beck, chairman, W. K. McNaught and Lieut.-Col. J. S. Hendrie. The engineering staff has seen more changes, however, chief of which was the resignation of Mr. P. W. Sothman, and the appointment of his successor Mr. F. A. Gaby, who holds the office of chief engineer at the present time Mr. Gaby has proved a thoroughly worthy successor to his former chief. He also understands local conditions thoroughly, being born and educated in the province.

Engineering Features and Additions

The constantly increasing demand for electric energy by the Hydro-electric Power Commission of Ontario has been largely responsible for the extensions to the generating station of the Ontario Power Company which now contains fourteen units with a total capacity of approximately 169,000 horse-power. The last seven units have been manufactured and installed by the Canadian General Electric Company and have a capacity of 12,500 kw. each. Generation, as in the original seven Westinghouse units, is at 12,000 volts. Fig. 2 shows the last four units installed, these being designated numbers 11, 12, 13 and 14. The first ten units, Fig. 7, are installed in a row and can be viewed from one point; the last four units, however, are placed at an angle and are partly hidden from view by the switchboard. The installation of the last of these units has just been completed.

Step-up Transforming Station

In the station on the hill current is stepped up from 12,000 volts to 110,000 volts. The original capacity in this station was 27,000 kv.a. but extensions at present under way and practically completed will bring the capacity up to 73,500 kv.a. The greater part of this capacity is to supply 110,000 volt lines running to Dundas, but it includes a capacity of 21,000 kv.a. in 46,000 volt transformers which are at present being installed to feed the power line being constructed to Welland, a town some twenty miles southwest of Niagara Falls. The plan of the Niagara Station as it will appear when complete has necessarily undergone considerable change as shown in Fig. 4. When this building is finished there will be space for eight banks of transformers, 12,000/110,000 volts, each bank to consist of three units of 3,500 kv.a. capacity each. At the present time five banks are installed with a total capacity of 52,500 kv.a. The station will also contain ultimately four banks of transformers 12,000/46,000 volts, each bank consisting of three units of 3,500 kv.a. capacity each. Two of these banks only are installed at the present time.

With the addition of extra transformers it has been necessary to add extra feeder cables. To feed the 110,000 volt transformers there have been installed, to the present time, four 12,000 volt underground feeder cables connecting the Ontario Power Company's generating station with the Commission's transforming station. All these feeders are carried in one conduit system.

Now, to supply the 46,000 volt power transformers which will serve Welland, 12,000 volt feeders placed in a separate conduit system are being installed. The specifications on this equipment called for six 300,000 c.m., three-conductor, paper insulated, lead covered cables.

The latest additions to 110,000 volt transformers were supplied by the Canadian Westinghouse Company. The general arrangement of the switching for the last bank is similar to that originally adopted. Both the 12,000 and 110,000 volt busses have been extended to connect up with the busses of the new equipment. The 12,000 volt feeder switches are of the reactance type and the 110,000 volt line oil circuit breakers operate on the same principle. Protection for the new 110,000 volt equipment is provided by electrolytic lightning arresters arranged with the arrester elements inside the station and the horn gaps on steel structures outside the building. The leads between the horn gaps and the arrester elements enter the building through porcelain bushings similar to those used for line wires.

The 46,000 volt transformers were supplied by the Canadian General Electric Company. These transformers have 12,000 volt primaries and 26,400 volt secondaries and are connected in star on the secondary side so as to give a line voltage of approximately 46,000. The switching and protective equipment was supplied by the Canadian Westinghouse Company and is similar to that provided for the high tension transformers, that is, feeder switch, bus switch, transformer switch with auxiliary bus and six 46,000 volt oil circuit breakers, two for transformers and four for lines with electrolytic protection for each line.

The feeder switches on the 12,000 volt side and the 46,000 volt line breakers are of the reactance type and the arresters have grounded tanks, a feature which eliminates one of the dangers to which a station operator is often subjected unless the apparatus is guarded by a screen or rail.

The completed new building will be about two and one half times the length of the original station and the arrangement of the high tension transformers and the switching apparatus will be similar to the present arrangement; the 12,000 volt switching equipment for the high tension transformers as well as the intermediate tension transformers will be arranged similarly to the existing apparatus. When the station is fully equipped there will be a line of over forty circuit breakers extending over a length of 360 feet.

The intermediate (46,000 volt) tension transformers will be placed opposite the high tension transformers in the extension across the track run-way. The switching for these will be placed on the main floor behind the transformers, whereas the 46,000 volt busses and lightning arresters will occupy the gallery extending over the transformers and oil switches. The 46,000 volt lines will leave the building on the side opposite to the 110,000 volt lines and will be carried around to the south end of the building on steel structures.

In place of individual transformer rooms for the 12,000 volt feeders all cables will terminate in one long room running the entire length of the new building. A basement is provided in the entire extension thus giving more space for transformer and switch piping. It is the intention to place the auxiliaries such as water pumps, oil pumps and oil feeders in the basement beneath the 46,000 volt oil switches.

The switching equipment installed in connection with the fourth bank of 110,000 volt transformers is of more rugged construction than that originally furnished. The placing in operation of the new oil switches with resistances in circuit has improved the service materially. These resistance circuit breakers are placed outside the building and work in conjunction with breakers inside the building. The two circuits are placed in series and when an overload occurs of sufficient magnitude to open the circuit the switch outside the station opens automatically and in so doing places a resistance between the line and the inside breaker thereby reducing the load on the oil switch inside the building which automatically opens an instant after the opening of the outside breaker.

Niagara Falls to Dundas

Increased demands for power as well as a desire on the part of the Commission for a still greater factor of safety in furnishing the various municipalities with continuous power, has led the Commission to decide upon the building of a second double circuit line between Niagara Falls and Dundas which will follow a different route from the first double circuit tower line.

This matter was only recently decided upon by the Commission and no construction work has yet been done. When completed it will be very similar in design to the high tension lines at present under completion between St. Thomas and Windsor. When this line is complete there will be four different circuits connecting Niagara Falls with Dundas carried by two steel tower lines following different routes. The new line will be 4/0 copper equivalent steel cored aluminium cable.

Dundas

Dundas is the main high tension distributing centre of the Niagara system so that the apparatus installed here consists largely of switching equipment. In order to provide space for the switching and protective equipment required with the new 110,000 volt lines from Dundas to St. Thomas which have been recently installed and for the extra double circuit tower line to be built from Niagara Falls to Dundas it has been necessary to plan considerable extensions to the high tension section of this building. This extension is ninety feet long and the full width of the old building. A basement has also been provided under one-half of the extension.

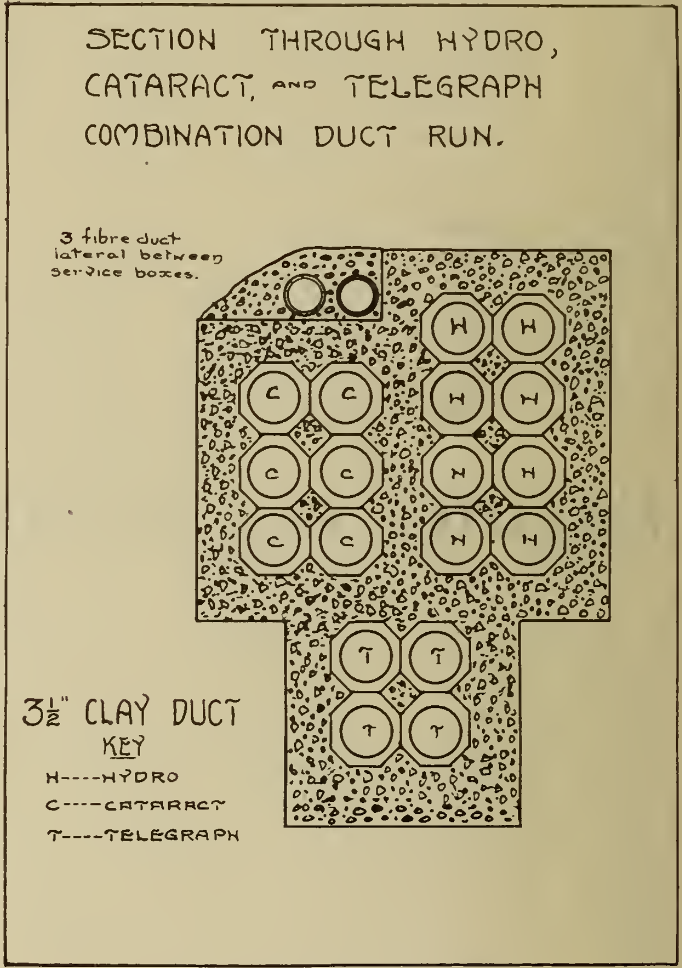

SECTION THROUGH HYDRO, CATARACT, AND TELEGRAPH COMBINATION DUCT RUN.
3 fibre duct lateral between service boxes.
3½" CLAY DUCT
KEY
H----HYDRO
C----CATARACT
T----TELEGRAPH
H
C
T

Fig. 3—Combination duct run, Hamilton.

For the new St. Thomas line there has been installed a 110,000 volt automatic circuit breaker, 110,000 volt disconnecting switches for connecting to each bus and a set of lightning arresters. The arrester tanks are placed inside the station and the horn gaps on special structures without the station. The arrester tanks are of the grounded type and an oil switch is installed for use in connecting the two 110,000 volt bus bars.

In addition, two sets of circuit breakers, disconnecting switches and lightning arresters will be installed in this station for the double circuit line being built from Niagara Falls.

The capacity of the low tension distributing end of this station has also been increased. The original installation was four 750 kv.a. transformers stepping the current down to 13,200 volts for distribution locally and in Hamilton. This number was later increased to six but on account of further demands for power the smaller transformers have been removed and replaced by six 1,250 kv.a. units taken from the Toronto station. The 750 kv.a. sizes are, of course, being used elsewhere on the system where the capacity requirements are less than in Dundas.

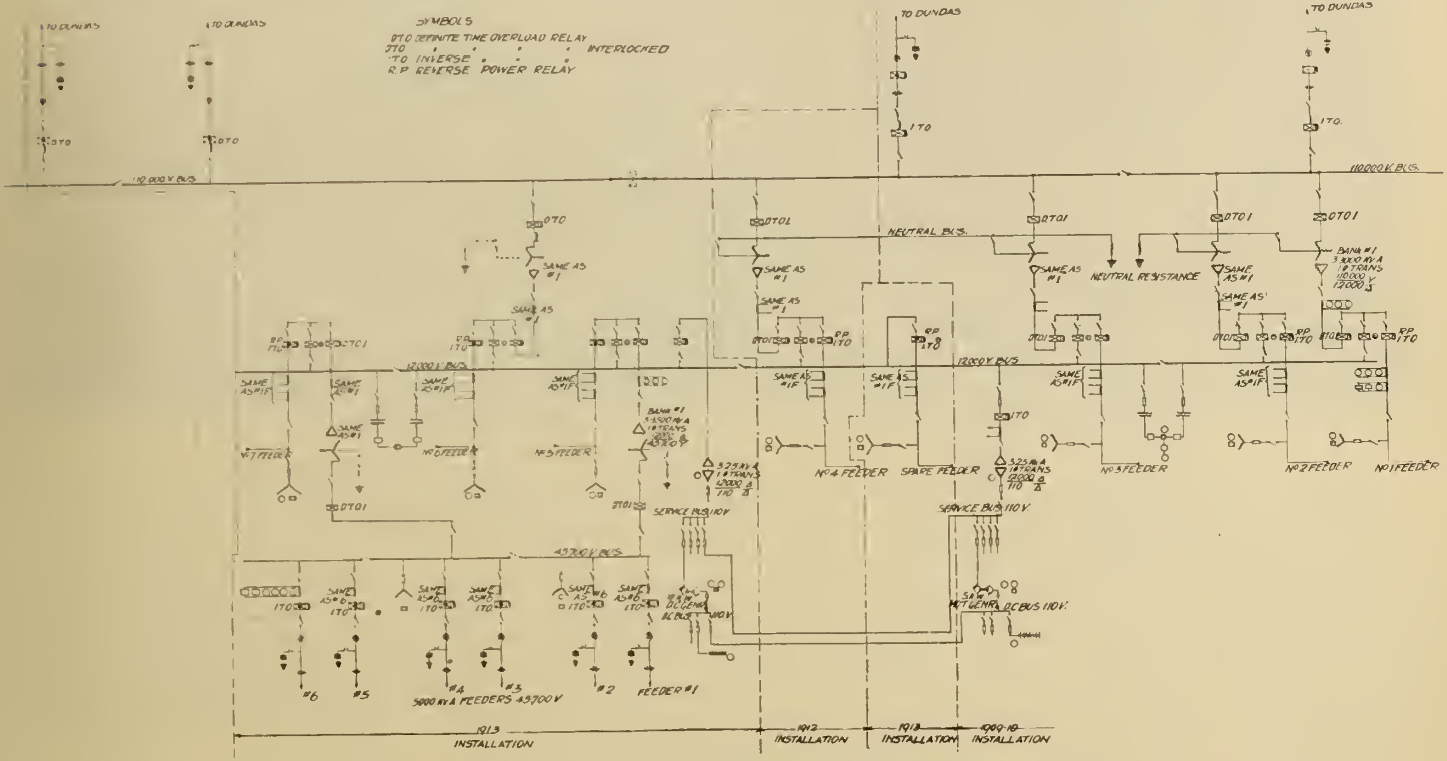


Fig. 4—Step-up transforming station at Niagara Falls.

At the present time there are eight 13,200 volt feeders leaving the Dundas station to supply Hamilton, Dundas, Waterdown, the Dominion Sewer Pipe Company, Caledonia, the Crown Gypsum Company, Hagersville, and Hamilton Asylum. Two of these lines have recently been put in for the city of Hamilton and the Canadian Westinghouse Company have supplied two of their type C. oil switches, two electrolytic lightning arresters, with a full complement of disconnecting switches, choke coils and other auxiliary apparatus. The original 13,200 volt bus bars have been extended to provide connection for the new feeders.

Hamilton

The Hamilton system is not yet completed. There will eventually be three sub-stations and much of the central distribution is underground. Some interesting features of this plant are treated elsewhere in detail.

Caledonia

It is to be understood that the stations in the various municipalities are of two kinds called (a) distributing stations and (b) municipal stations. By a "distributing station" it is meant that the station is owned by the Hydro-electric Power Commission of Ontario as is also the equipment it contains. The obligation of the municipality starts with the 2200 volt line in this case. The expenditure in connection with these stations incurred by the Ontario Hydro-electric Commission for the municipality constitutes a loan which is to be taken care of eventually by the municipality and on which carrying charges are paid in the mean time.

A "municipal station" means that the municipality has built and equipped the station at its own expense. For the most part, the distributing stations are installed in smaller municipalities where the immediate expenditure is greater than the municipality can bear comfortably. This is one of the many co-operative features of the Ontario Hydro-electric municipal system which makes it possible for a small municipality to obtain power when otherwise the initial expenditure would make it impossible to do so.

Caledonia is a distributing station and there has been installed 13,200/2300 volt transformers of 450 kv.a. capacity. No unusual engineering features have been introduced into any of these stations, all having been installed according to standard practice.

Waterdown

This also is a distributing station containing 225 kw. capacity in 13,200/2300 volt transformers. Two 2300 volt lines run out from Waterdown, one to serve the local requirements and one to the Dominion Sewer Pipe Company.

Hagersville

Hagersville is a distributing station containing 225 kw. in capacity, of 13,200/2300 volt transformers.

The Crown Gypsum Company

The plant of the Crown Gypsum Company is located at Lythmore and the only property of the Commisson installed in this station is a recording watt meter for metering power which is supplied to the company at 13,200 volts. Transformers, switching equipment and protective equipment were all supplied for this station by the company.

Town of Dundas

The low tension equipment for power distribution locally in Dundas is situated in the high tension station. The total equipment consists of three 150 kv.a. units each stepping 13,200 volt current down to 2,300 and 575 volts.

Other High Tension Extensions to Original System

The original line from Dundas through Woodstock to London and south to St. Thomas was a single circuit No. 3/0

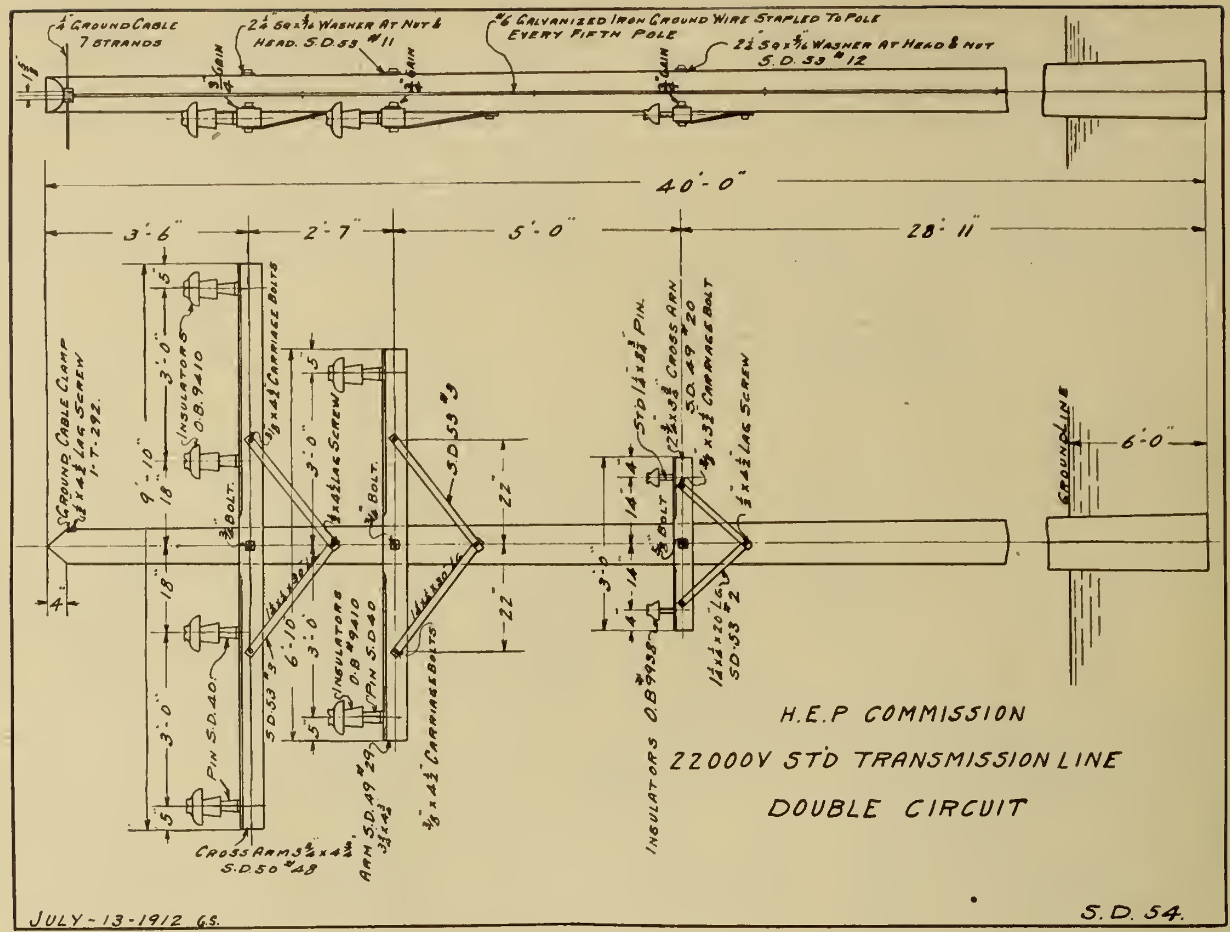


Fig 6. Standard 22,000 volt pole design.

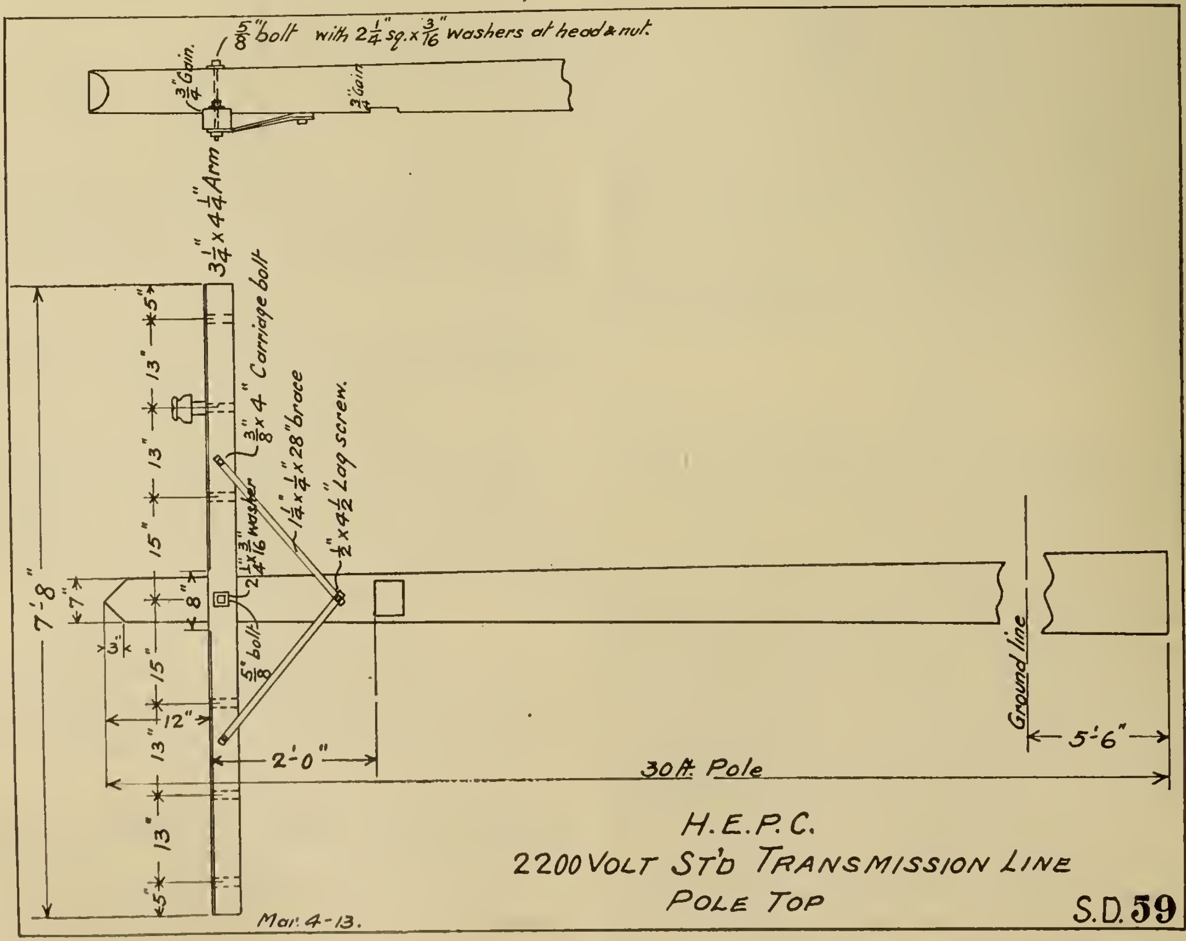


Fig. 5. Standard 2,200 volt pole design.

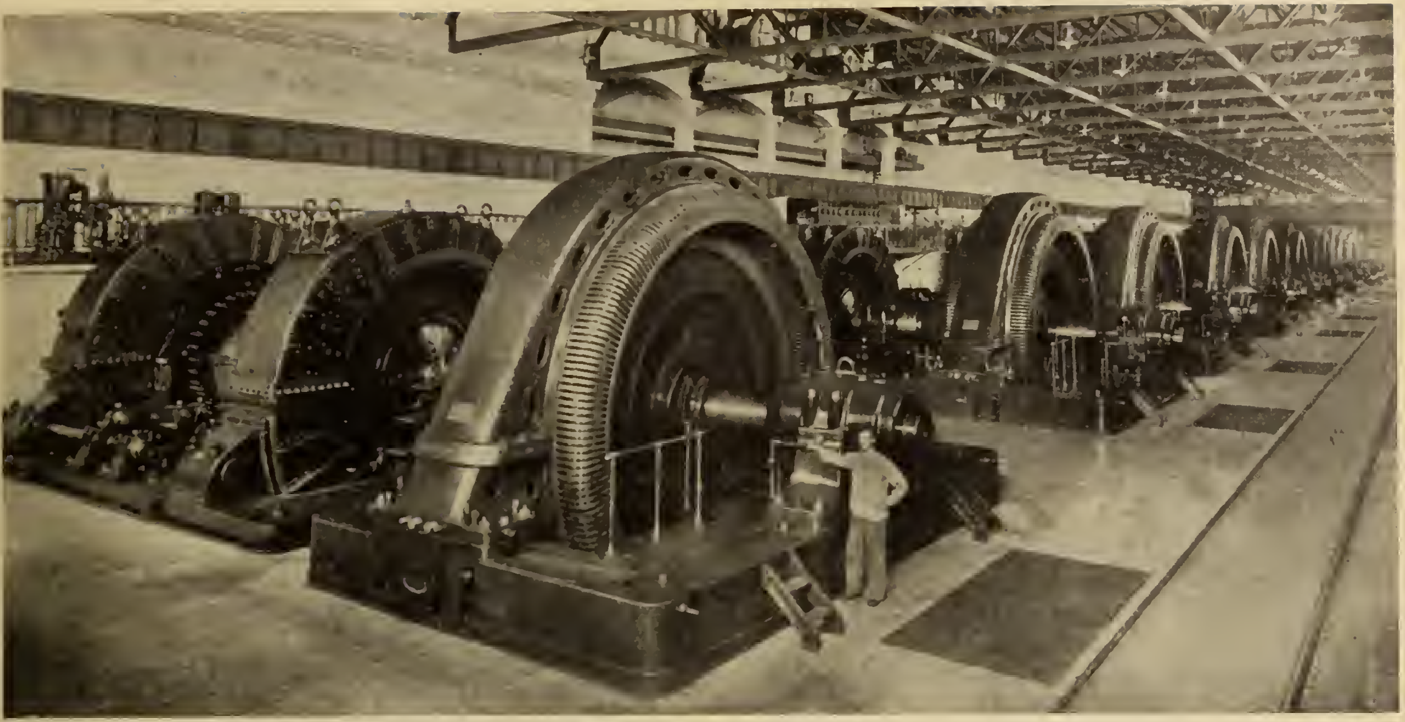


Fig. 7—Units 1 to 10 inclusive, Ontario Power Co. With units shown on page 56 total capacity is 169,000 h. p.

aluminium cable. Owing to the increased demand anticipated on the new section west of St. Thomas the 3/0 line has been replaced by two circuits of 4/0 copper equivalent steel reinforced aluminium cable between Dundas and London and by two circuits of 3/0 copper equivalent steel core aluminium cable between London and St. Thomas. The steel reinforced aluminium cable was only adopted after the most careful investigation. These extensions are not quite completed to date, but work is being rushed.

Toronto

A double circuit 110,000 volt line was originally installed between Dundas and Toronto and the carrying capacity of this line has been sufficient up to the present time. Toronto's original transforming equipment consisted of six 1,250 kv.a. capacity units. These have since been moved to Dundas station, as explained elsewhere, and seven 2,500 kv.a. transformers supplied by the Canadian General Electric Company have been installed. The Toronto station has been enlarged sufficiently to accommodate three additional banks of transformers as well as other equipment which the local Toronto Hydro-electric System use for supplying low voltage power in the vicinity of the transforming station. A further order for three additional 2,500 kv.a. transformers has also just been filled by the C. G. E. company so that the completed capacity of Toronto's station is now ten 2,500 kv.a. transformers representing three banks of three with one spare. In connection with the latter contract the same company also supplied a 110,000 volt oil switch, disconnecting switches, and the necessary extension to the existing bus line for connecting up the new equipment. The contract also includes the necessary 13,200 volt switching equipment for the new bank of transformers and an additional switchboard.

Cooksville

The equipment in this station has not been increased since it was first placed in operation early in 1912, and consists of four 1,250 kv.a. units stepping down from 110,000 to 13,200 volts. There were originally four 13,200 volt lines leaving this station but on account of the increased demands of this district four more feeders have been added. The equipment consists in each case of an automatic oil switch and electrolytic grounded tank type lightning arrester, disconnecting switches, choke coils, switchboard and panels and a full complement of indicating and recording meters. All this equipment was installed by the Canadian Westinghouse Company. The eight points served from Cooksville are the local service in Cooksville, Port Credit, Brampton, Weston, Milton, Streetsville and Mimico. From the distributing station at the latter point two 2,300 volt lines pass out, one for local service and one for the Mimico asylum.

The distribution stations supplied from this high tension sub-station are Cooksville village, Port Credit, Mimico, and Streetsville. Cooksville is supplied by 50 kva. in transformers; Port Credit by 225 kv.a. transformers; Mimico by 225 kv.a. transformers; Streetsville by 225 kv.a. In the latter case transmission is at 4,000 volts instead of at 2,300 as in the other three cases, the higher voltage being obtained by connecting the transformers in star on the secondary side.

Guelph

The capacity of the Guelph transforming station has not been materially changed. The original equipment consisted of four 750 kv.a. units and these have been replaced by the four units of the same rated capacity taken from Dundas Station, the advantage being in that the Dundas units were found to have a capacity considerably in excess of their normal rating. The four units originally placed in the Guelph station have been transferred, two to Preston and two to Berlin. No building extensions have therefore been incurred in Guelph.

Running out from the Guelph station there are now six sets of 13,200 volt lines serving respectively the city of Guelph, the Ontario Agricultural College, the Central Prison Farm, and the towns of Acton, Georgetown, and Rockwood.

Distribution stations have been established at Acton, Georgetown and Rockwood. At Acton there is a capacity of 225 kw. in 13,200/2,300 volt transformers. At Georgetown there is 225 kw. capacity in 13,200/4,000 Y connected transformers and in Rockwood there is 75 kw. capacity in 13,200/2,300 volt units. The Rockwood station is an outdoor type, the first of its kind to be used by the Commission. The transformers are C. G. E. outdoor type mounted on a platform supported by wooden poles. They are connected to the line through horngap disconnecting switches and 13,200 volt fuses.

A municipal station has been established at the Central Prison Farm containing three 100 kv.a. units 13,200/2,300 volts.

A double circuit 13,200 volt line supplies the Ontario Agricultural College where a municipal station was installed in 1911.

Berlin

The Commission's station capacity has been increased to 4,500 kv.a. by the addition of two 750 units. Power is now distributed locally in Berlin by a 13,200 volt line, and four other 13,200 volt circuits serve Waterloo, New Hamburg, Baden and Elmira. From Baden two 2200 volt lines pass out, one for local service and a second to St. Agatha, a village in the vicinity.

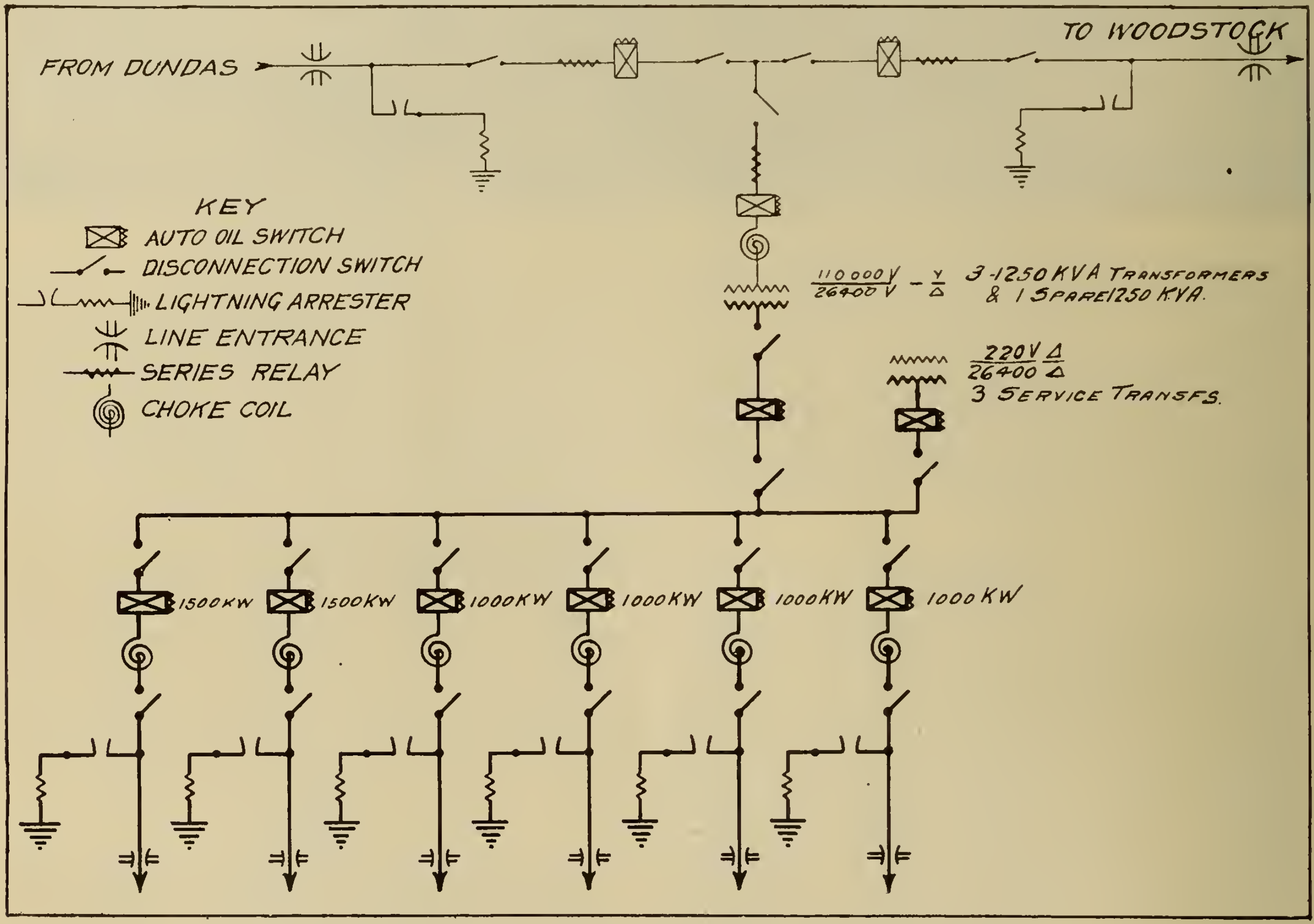


Fig. 8—Wiring diagram of Brant Sub-station—5,000 kv.a. feeding Brantford and Paris.

Three distributing stations are served from Berlin, namely, New Hamburg, Baden and Elmira. New Hamburg was one of the earliest municipalities to take advantage of Niagara power. In each of these stations a capacity of 225 kv.a. has been installed, distribution being at 2200 volts except in the case of Elmira which is at 4,000 volts, through Y connected transformers.

Preston

The original equipment of four 750 kv.a. transformers has been increased by the addition of two more 750 kv.a. units. This brings the capacity up to 4500 kva. Power is now supplied locally in Preston by a 6,600 volt line which connects the high tension station with the town's sub-station Four other 6,600 volt lines leave the Commission's station to supply Galt, Breslau, Hespeler and the Galt, Preston and Hespeler Railway Company.

The only distribution station served from Preston high tension station is Breslau where there is a total capacity of 225 kv.a. 6600/2300 volt transformers. The towns of Galt, Preston and Hespeler and the Galt, Preston & Hespeler Street Railway own their own transforming equipment.

Stratford

Owing to the addition of Goderich and Clinton to the Stratford demand the equipment in the high tension station has been more than doubled. The original capacity was 3,000 kv.a. made up of four 750 kv.a. units comprising three working units and one spare. These were used to serve the local requirements and two 13,200 volt lines were also constructed to serve Seaforth and Mitchell. During the past year an order was placed and the installation is just completed of four 1250 kv.a. units to step current down from 110,000 volts to 26,400 volts. From these transformers two 26,400 volt lines have been built one to Goderich and one to Clinton, the higher voltage being decided on as a result of the greater distance of these towns from the Stratford station. The four new units which include one spare, were supplied by the Canadian Westinghouse Company. They are of the water cooled type. The necessary 110,000 volt oil switches, disconnecting switches, and the necessary extensions of the high tension bus lines were supplied by the Canadian General Electric Company. The latter company also supplied the 26,400 volt transformer oil switches, the 26,400 volt bus bars, the four feeder switches, electrolytic lightning arresters and the necessary switchboard and auxiliary apparatus. Provision has been made in this station also whereby 13,200 volt power can be obtained from the new bank of 26,400 volt transformers in case of trouble in the originally installed units.

The installation of this additional equipment has necessitated the extension of the original sub-station building which work is practically completed.

Goderich

All the stations served by Stratford are municipally owned the most recent of which are Goderich and Clinton. These two towns are supplied with power at 26,400 volts.

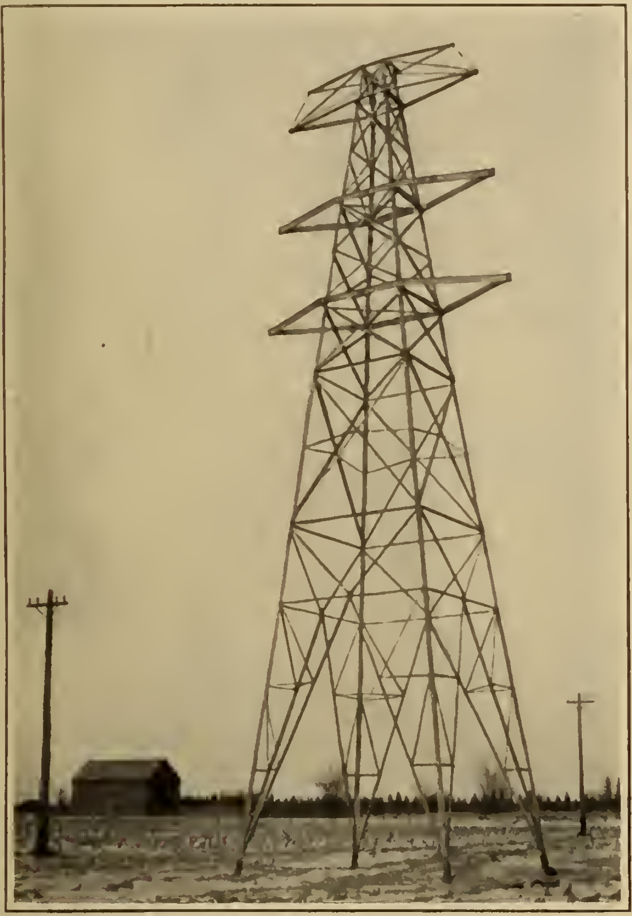


Fig. 9—Standard Line Tower—Windsor Extension.

The Goderich station contains one bank of three 250 kv.a., 26,400/13,200 volt transformers and switching equipment for one incoming 26,400 volt line. The outgoing feeder lines include one 600 kv.a. power feeder, one 250 kv.a. three-phase lighting feeder and two series lighting feeders. There is one 3-phase regulator switch connected to the secondary taps of the transformers to regulate the voltage from 2200 volts to 2500 volts in 100 volt steps. Two 15 kw. single-phase, 25-cycle constant current transformers are installed in connection with the lighting system. The equipment was supplied by the Canadian General Electric Company.

The Goderich equipment is installed in the building which formerly was used as a municipal power generating station, the necessary alterations being made in accordance with the Ontario Commission's plans.

The Goderich metering equipment consists of a recording wattmeter and a recording power factor meter. These meters are connected on the secondary side of the transformers.

The town of Goderich operates its domestic water system electrically and there has been installed a 700-gallon per minute pump to operate against a 340-foot head and a 1450 gallon per minute pump to operate against a 480-foot head. These pumps are connected to synchronous motors which also have an influence in correcting the power factor.

Clinton

This station contains three 150 kv.a. 26,400/2,300-2,300/575 volt transformers of the self-cooled type with the necessary switching equipment for two incoming 26,400 volt lines. There is also one 300 kv.a. power feeder and one 150 kv.a. lighting feeder. The equipment was all supplied by the Canadian General Electric Company. Further equipment by the same company includes a recording wattmeter and a recording power factor meter connected to the secondary side of the transformers. There has also been installed a 150 kv.a., 750 r.p.m., 2300 volt, 25-cycle synchronous motor to be used for power-factor correction and by connection to a line shaft for any other purpose for which power is required.

The original service to Stratford city, Seaforth and Mitchell is at 13,200 volts.

St. Marys

No additions have been made to the original 3,000 kv.a. capacity. The town's principal customer is the St. Marys Portland Cement Company. A transforming station was supplied by the Cement Company and three 500 kv.a. water-cooled transformers were installed by the Commission to reduce the current from 13,200 to 575 volts for power purposes. It is intended in the near future to send out a supply of power from their station to Granton, Lucan and Ailsa Craig.

The St. Marys Portland Cement Company has an installed capacity of 1500 kv.a. belonging to the Commission. The current is stepped down here from 13,200 volts to 575 for motor operation. This is the only service leaving this station at present outside of the requirements of the town of St. Marys.

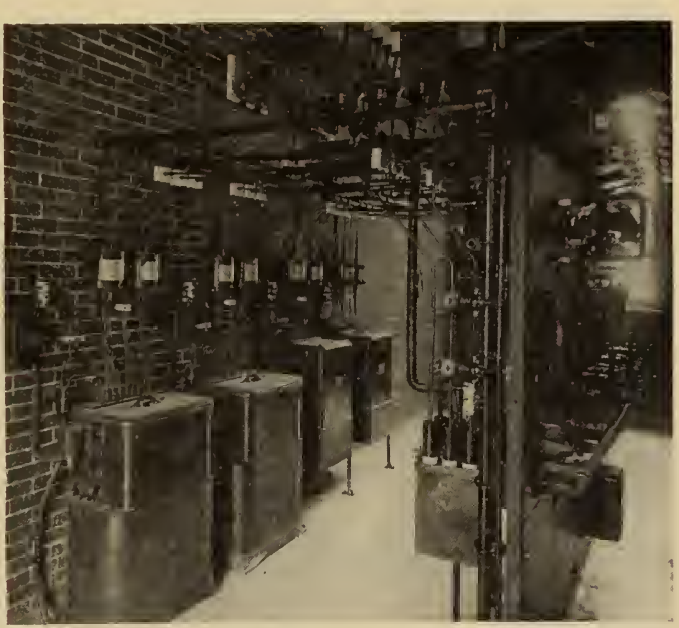


Fig. 10—Hamilton Pumping Station—C.G.E. Switch board, rear view.

Woodstock

No additions have been necessary to the 3,000 kv.a. equipment in this station. Service was originally supplied to Ingersoll, Tillsonburg and Norwich as well as locally. A distribution station has been constructed at Beachville and 150 kv.a. capacity installed. During the past year a 2,200 volt rural line has been run out for some distance in West Oxford; this line is supplied from the sub-station belonging to the city of Woodstock.

Two distribution stations, Norwich and Beachville, are served from the Woodstock sub-station, each with a capacity of 150 kv.a. As noted elsewhere it has been adopted as a standard arrangement by the Commission that in the case of villages power should be supplied at 2,300 volts which necessitates no transformer station for these municipalities. All that is necessary is to make use of pole type transformers stepping down to the voltage required for lighting or power. This is the case in Norwich and Beachville.

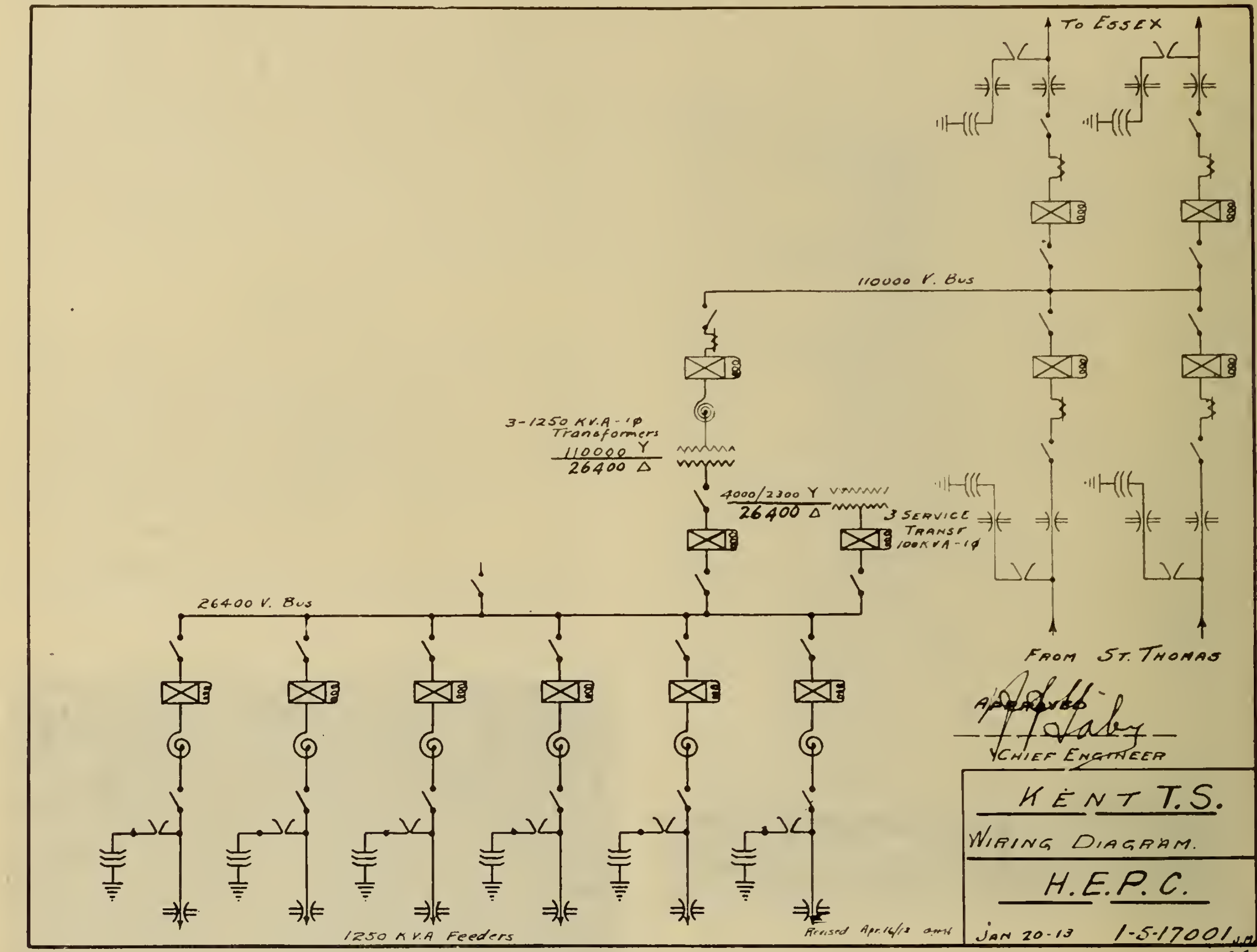


Fig. 11—Wiring diagram of Kent 110,000 volt sub-station, on the Windsor Extension. For key see Fig. 8.

London

The original transformer equipment installed in London consisted of four 1,250 kv.a. units, and no additions have been made since that time. 13,200 volt feeders pass out of this station for local service as well as one to the London Asylum and another to Dorchester. The equipment in Dorchester consists of three 25 kv.a. units which will be sufficient to supply the local requirements of Dorchester as well as Thamesford and Thorndale, distribution to these latter villages from the Dorchester station being made at 2,200 volts.

Extensions to the London transforming station were necessary on account of the new 110,000 volt line which has been strung from Dundas through London to St. Thomas. The new equipment installed consists of an automatic 110,000 volt oil circuit breaker for connecting London station to the new line from Woodstock and a similar breaker for connecting the new line to St. Thomas. These circuit breakers, as well as the necessary bus-bar equipment, switches and two 110,000 volt lightning arresters were installed by the Canadian Westinghouse Company.

The only distributing station served from London is Dorchester and at this point there is only 75 kv.a. capacity transmitted at 4,000 volts. From this distributing station power is also supplied at 4,000 volts to Thamesford and Thorndale where it is stepped down by pole type transformers for lighting purposes. The other 13,200 volt services from the London high tension station supply the local London sub-stations and the London asylum.

St. Thomas

With the extension of the 110,000 volt line west to Windsor, St. Thomas is no longer the terminal point on the line. To accommodate the switching equipment required on the new 110,000 volt circuit from London and for the double circuit line running west to Windsor it has been necessary to construct a thirty-two foot extension to the high tension portion of the building.

The equipment installed in connection with the new line consists of one automatic 110,000 volt oil circuit breaker for connecting St. Thomas station to the new line from London, two similiar breakers for connecting the new double circuit line running west to Windsor and one transformer bank automatic oil circuit breaker.

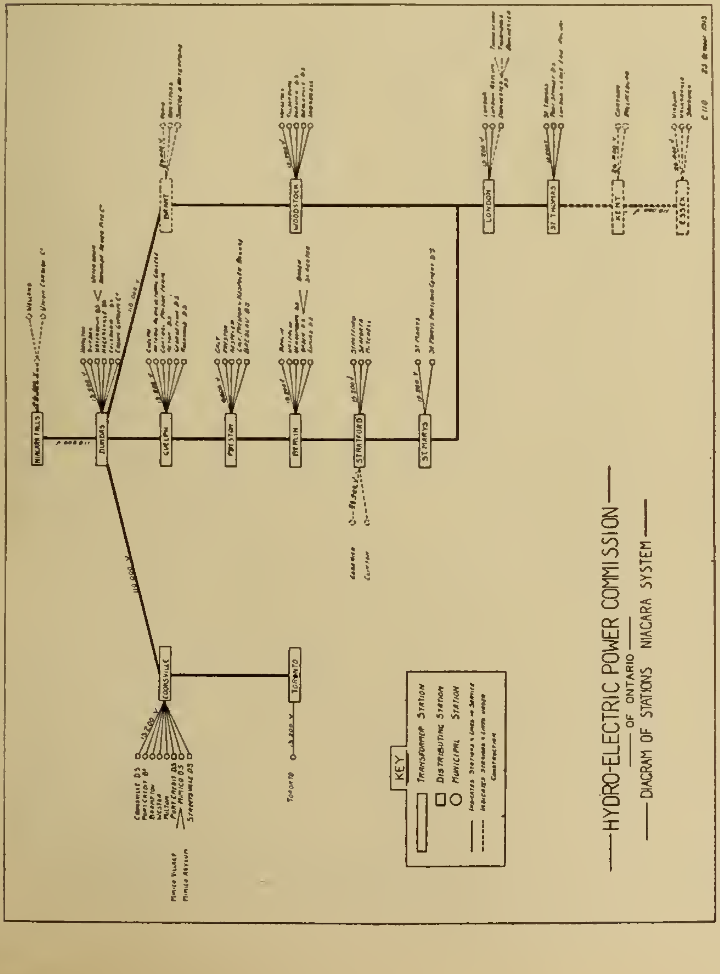


Fig. 12. Diagram of municipalitie served by Niagara system.

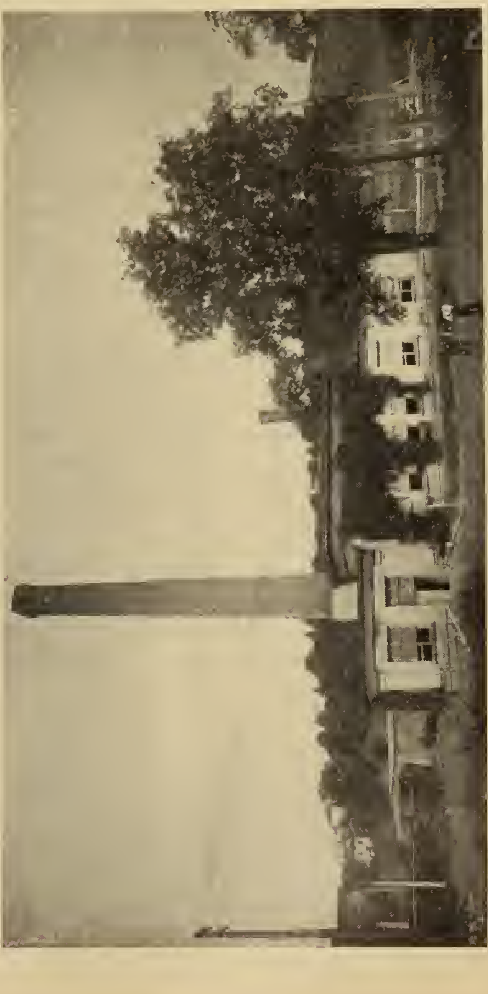


Fig. 13. Preston Power Station.

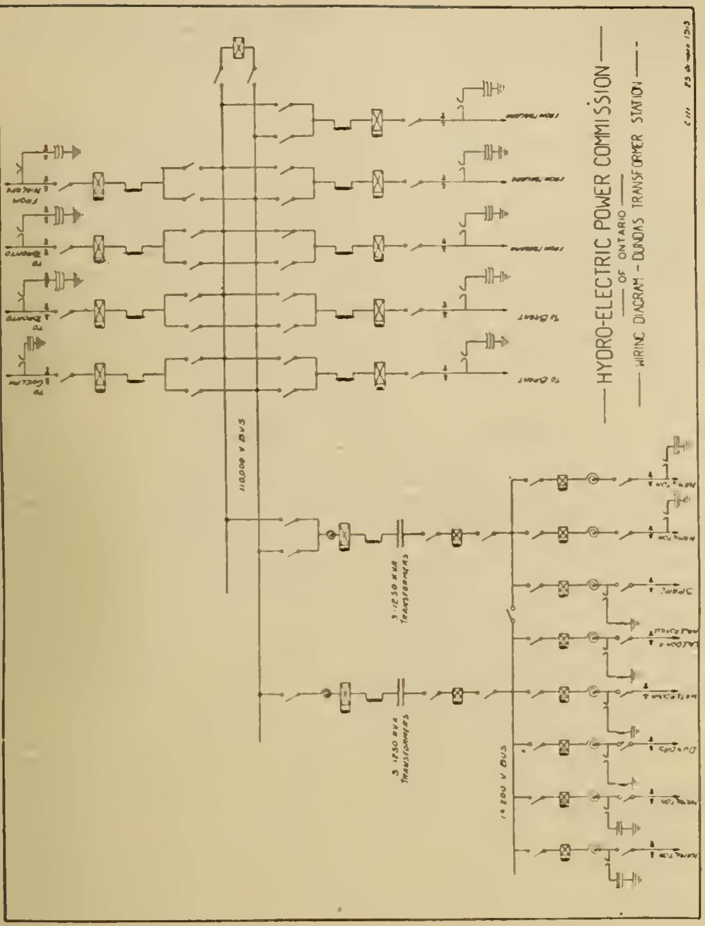

HYDRO-ELECTRIC POWER COMMISSION
OF ONTARIO
WIRING DIAGRAM - DUNDAS TRANSFORMER STATION
110,000 V BUS
13,200 V BUS
TRANSFORMERS
TO BRANT
DUNDAS

Fig. 14 - Wiring diagram of Dundas Inter-switching station.

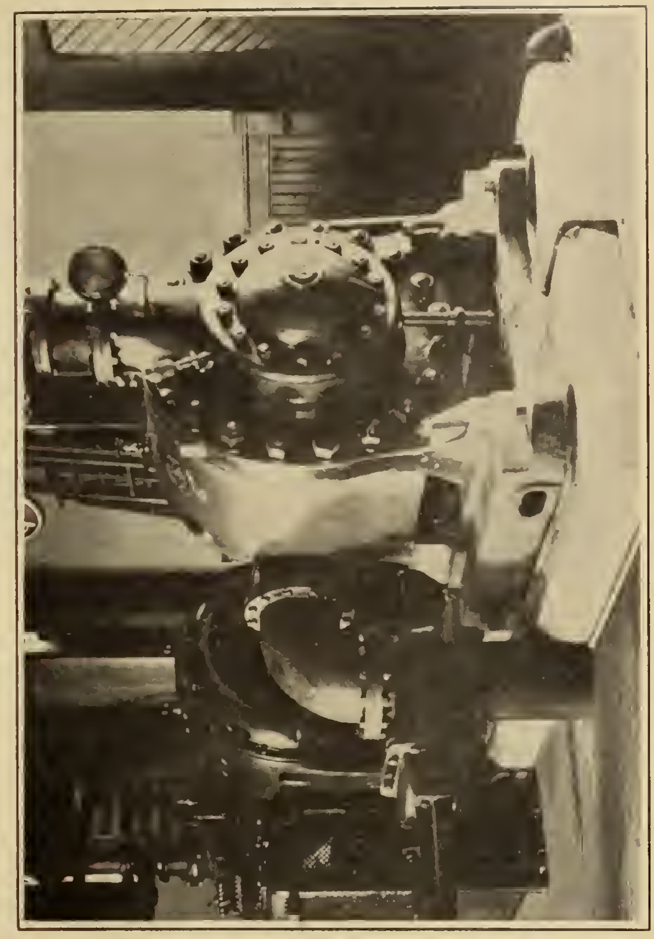


Fig. 15. Water works pumps in Galt.

The necessary bus bar extensions and disconnecting switches have also been installed. Three additional 110,000 volt lightning arresters have also been placed, one each protecting the two new lines west and one on the line from London. The arrester tanks are of the grounded type and are located inside the station with the horn gaps on steel structures outside. The Canadian Westinghouse Company supplied the equipment.

Additions to the low tension equipment in this station include a feeder panel and oil switch as well as the necessary equipment for supplying two outgoing feeders from one oil switch. Construction work has been completed in connection with the installation of a 13,000 volt oil switch with panels, meters and auxiliary equipment for supplying The London & Lake Erie Railway & Transportation Company.

The low tension lines passing out of the station are used for serving respectively the local requirements, Port Stanley and The London & Lake Erie Railway & Transportation Company.

In the distributing station at Port Stanley 150 kv.a. capacity has been installed.

Brant

The Brant Station, situated between the cities of Brantford and Paris, and used to serve both municipalities as well as any other corporations in the vicinity which may contract for a supply of power in the future, was only completed early in the present year. This station is on the direct line of the Dundas to Woodstock to London transmission. The 110,000 volt lines enter the station through oil circuit breakers on to the bus and pass out through similar breakers to the line. Both the incoming and outgoing lines are provided with electrolytic lightning arresters. The transformer equipment consists of four 1,250 kv.a. single-phase, oil insulated transformers three of which are connected in star on the high tension side and in delta on the low tension side. The fourth transformer is held as a spare.

The arrangement of the station is shown in Fig. 8. It will be seen that the lightning arrester tanks are placed inside the building. The transformers step down to 26,400 volts instead of 13,200, as in other stations—except recent extensions in Stratford. There will eventually be six 26,400 volt feeders each protected by an electrolytic lightning arrester of the grounded type. The Canadian Westinghouse Company supplied the complete equipment.

On account of the higher secondary voltage used in this station the arrangement is somewhat different. In the Brant station there are two galleries in the 26,400 volt section, the lower to accommodate the feeder and transformer switches, bus-bar and current transformers. The upper gallery contains the electrolytic lightning arresters. The space below the gallery is completely enclosed, and contains the switchboard.

A feature of this station is that is is heated throughout electrically by use of 10 kw. electric radiators in sufficient numbers to maintain the temperature at 65 deg. F. in the operating room, and at 50 deg. F. in the balance of the building, under the worst weather conditions likely to be encountered. During the peak load the radiators are cut off. A 45-ton crane with electric and hand hoist and a transformer truck are installed.

Brantford

The equipment in the city of Brantford municipal sub-station consists of two 750 kv.a. 26,400-13,200/4,000/2,300, 25-cycle, water-cooled, three-phase transformers. These were supplied by the Canadian Crocker Wheeler Company. Further equipment includes switching and protective apparatus for the transformers; two incoming 26,400 volt lines, three 4,000/2,300 volt, four-wire three-phase lighting feeders, three 4,000/2,300 volt four-wire, three-phase power feeders, and one 4,000/2,300 volt, four-wire, three-phase feeder to the constant current street lighting transformers. These were supplied and installed by the Canadian General Electric Company.

Paris

This station contains three 200 kv.a. 26,400-13,200/2200-575 volt, 25-cycle, oil insulated self-cooled C. G. E. transformers and three 15 kw. 6.6 ampere 25-cycle constant current transformers. The same company supplied switching equipment for the above and for the two 26,000 volt incoming lines, also one 600 kv.a., 2300 volt power feeder; three 150 2,300 volt, three-phase lighting feeders and three series street lighting feeders. This equipment is installed in the old power house in which the necessary changes have been made.

The Windsor Extension

The surveys for the route of the Windsor Transmission Line were commenced in January, 1913, although a considerable amount of preliminary investigation was done during the years 1911 and 1912. Early in January, 1913, an exhaustive study was begun of routes between St. Thomas and Windsor, taking into consideration relative costs, right of way, length of line, difficulties of construction of tower and wood pole lines, necessity for bridging and the general character of the country passed through. Several different routes were investigated and the following finally adopted.

Commencing at the St. Thomas sub-station, this line runs in a westerly direction a distance of 1.4 miles to the intersection of the Edgeware Road and crosses the Southwestern Traction and the Wabash Division of the Grand Trunk. It then deflects to the left and paralleling the Edgeware Road, it runs for a distance of 7 miles to a point immediately south of the Michigan Central Railway near the Village of Shedden. In this section it crosses Dodd's Creek and the main line of the Michigan Central Railway. At Shedden the line deflects to the left crossing the Pere Marquette Railway there and parallels this railway for a distance of 37.1 miles to a point just west of Ridgetown. In this section it passes through the villages of Shedden, Iona, Dutton, West Lorne, Rodney Muirkirk and Highgate, and after crossing the Pere Marquette Railway just east of Ridgetown, passes through the northern part of this town. At this point it deflects to the right and runs straight across country, a distance of 10.7 miles to a point in Lot 7, Concession 3, R.T. Township of Harwich. In this section the main line of the Michigan Central Railway is crossed. The line then deflects to the left and paralleling the road allowances, runs in a southwesterly direction through the City of Chatham, a distance of 3.5 miles, to a point in Lot 20, Concession 2, R.T. Township of Raleigh. At this point it deflects to the right and parallels the G. T. R. immediately to the south of it for a distance of 3.3 miles to the intersection of this railway with the Canadian Pacific Railway. It then deflects to the left and parallels the Canadian Pacific Railway immediately on the south side of it for a distance of 39.8 miles to Walkerville Junction. The total length of this line is 102.8 miles, being much the shortest line of all those investigated. For many reasons it was the most economical to build on account of the great length of line which parallels and is adjacent to railway lines, right of way would be much cheaper than any other line investigated. Also construction was carried out at a lesser cost on account of the railway facilities for distribution of material. From Chatham to Walkerville Jct. the amount of bridging necessary was slightly more than that of any other line on account of the fact that it is much closer to Lake St. Clair where the rivers and drains are much larger. This, however was not a serious matter and would count very little against the choice of a location.

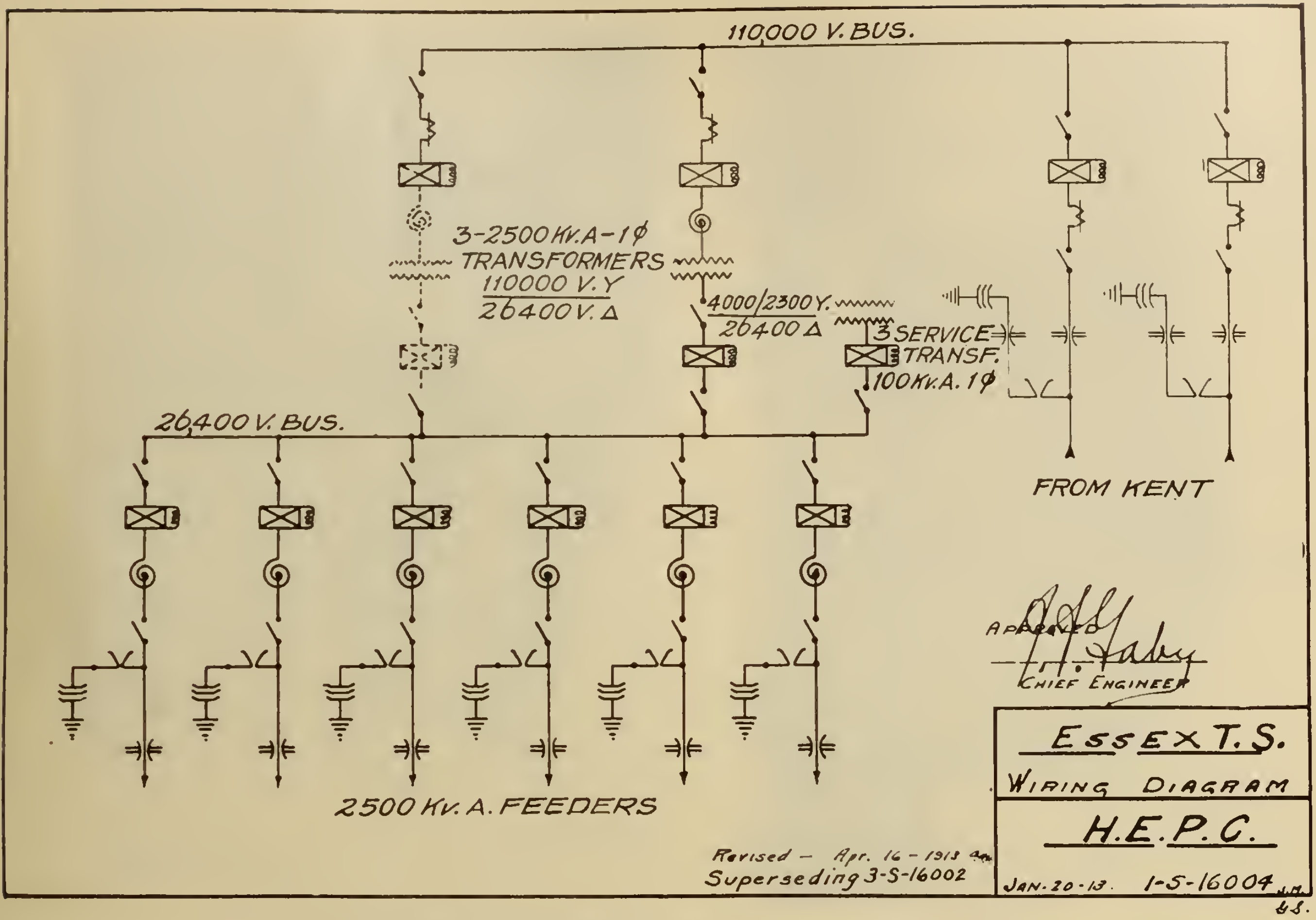


Fig. 16—Wiring Diagram of Essex Station—The Western Terminus of the high voltage line.

During the latter part of 1912 various types of transmission line construction work were considered, and it was decided to use tandem construction, where the three wires of each circuit would be in one plane approximately vertical, and removed about 7 feet from the face of the conductor support.

On account of market and other conditions, No. 3/0 B. & S. gauge copper cable was specified for conductors, and a standard span of 660 feet between conductor supports was adopted.

Early in 1913 instructions were issued by the Commission to undertake the work of construction of the Windsor transmission and telephone lines, following plans similar to the construction of the low tension lines, and an organization was formed to take care of this work. The gangs employed for transmission line work were as follows:—

Two gangs, each of about 25 men, excavating for tower footings.

Two gangs, each of about 20 men, setting tower footings.

One gang of about 10 men building culverts and bridges, and temporary fencing.

One gang of about 12 men clearing right-of-way.

Two gangs, each about 25 men, assembling towers.

Two gangs, each 7 men, erecting towers.

The unloading of tower steel was done by a gang of six men, and the steel was delivered to the tower locations by teams hired along the line.

Each one of the above gangs was in charge of a foreman, who received his instructions from the general foreman in his section.

The gangs employed for telephone line work were as follows:—

One gang of 15 men digging holes.

One gang of 10 men erecting poles.

One gang of 3 men unloading and framing poles.

One gang of 4 men assembling and erecting cross arms, setting anchors and attaching guys.

One gang of 8 men stringing wire.

Each of these gangs was in charge of a foreman, who received his instructions from the general foreman of the telephone line.

The work of excavating and setting tower footings was begun July 1st, 1913, and was carried forward at such a rate that on October 31st only 76 of the 860 footings remained to be set. The footing gangs met with a good deal of trouble from water in the case of tower footings from Chatham to Tilbury. These were the first set, and the ground was still full of water. Also in the neighborhood of Ridgetown, West Lorne, and Dutton, a good deal of quicksand was found, and shoring of the holes was necessary. In all cases, however, a good solid bottom was reached at the standard depth.

Culverts and bridges were commenced a week ahead of the tower footings and were kept well in advance of this work throughout.

Tower assembling was begun on October 7th and the first tower was erected on October 14th. Up to the end of the month 52 towers had been assembled and erected.

Work on the telephone line was begun early in August and the first pole erected on August 16th. The digging of holes and erecting of poles was carried forward rapidly, so that this part of the work was practically complete from Chatham to Windsor by October 31st. At date of writing the transmission line is practically completed.

Owing to the fact that this work was carried out by the Commission instead of by contract a considerable saving was effected in the total cost as compared with previous estimates. The right of way of this tower line is sixty-six feet wide and was purchased outright by the Commission. The

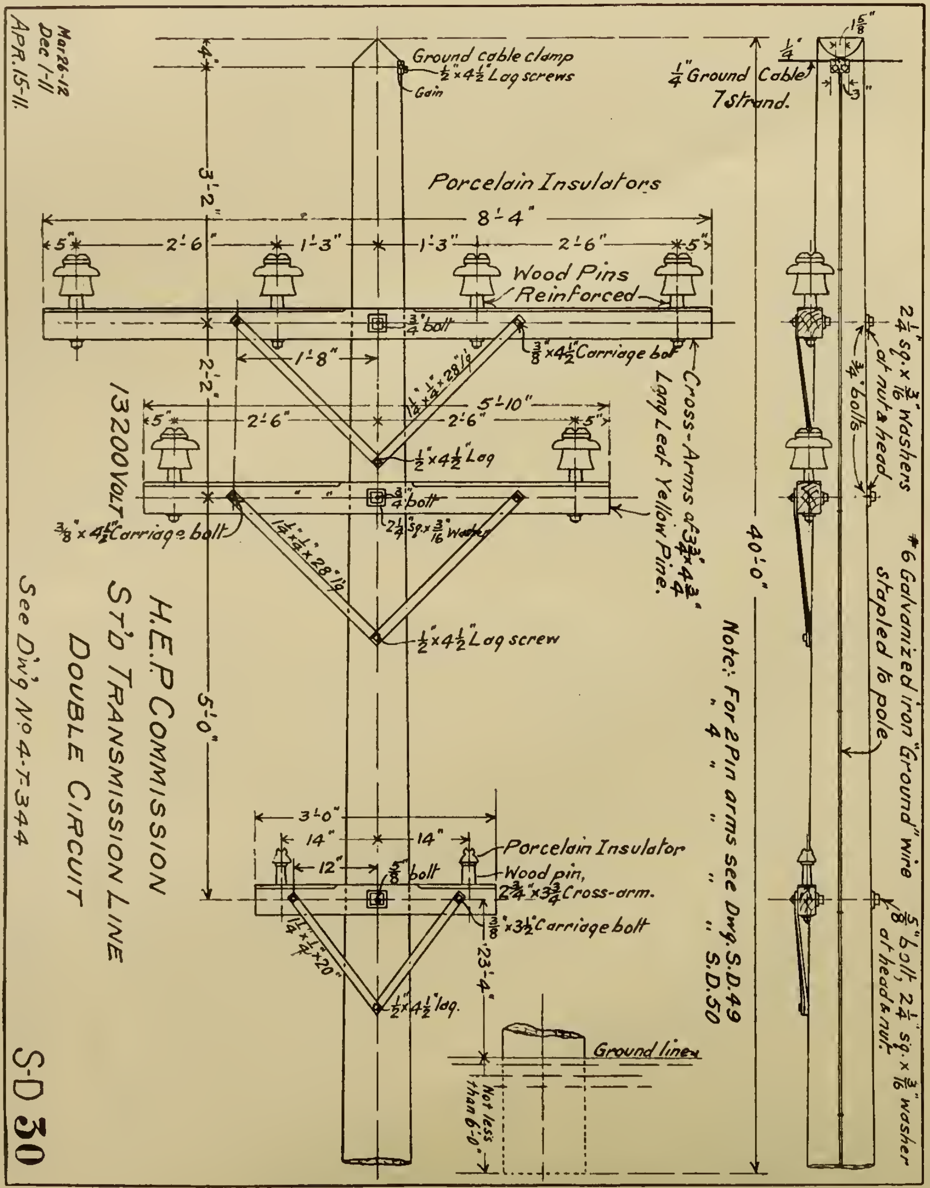


Fig. 17—Standard 13,200 Volt Pole Line.

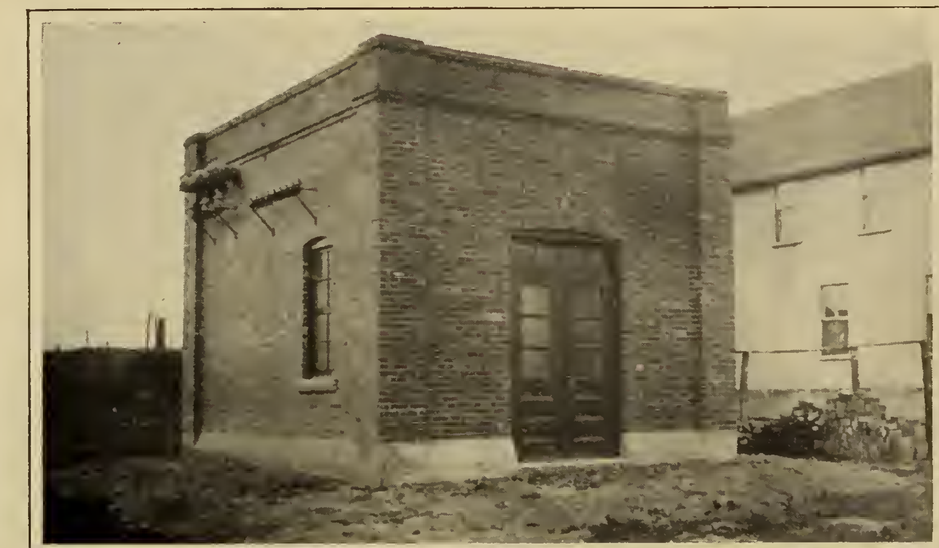


Fig. 18—Typical Distributing Station, 13,200 2,300 volts—Mimico.

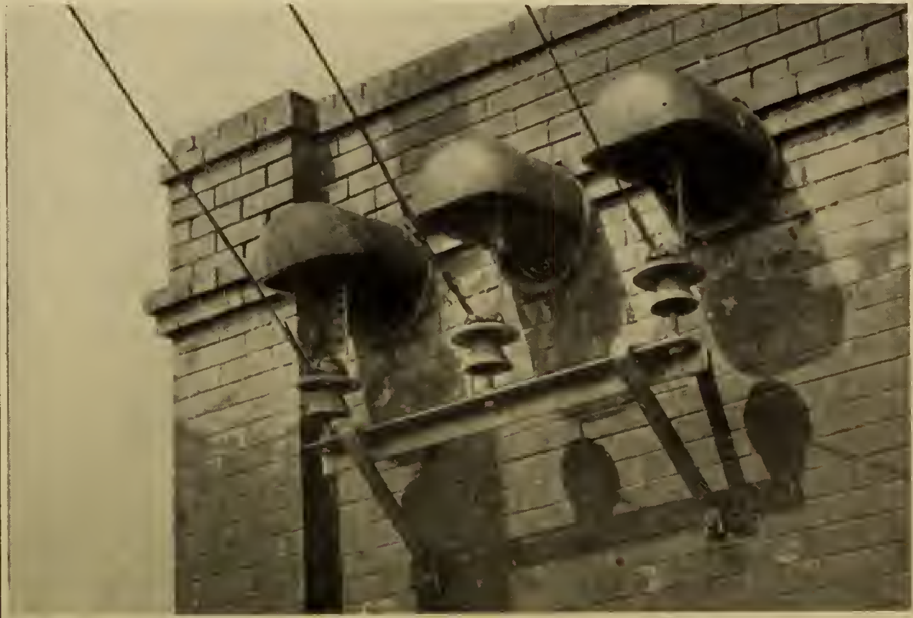


Fig. 19—Standard 13,200 Volt Entrance Hoods.

high tension tower line is placed at one side of the right of way and the telephone line at the other side, leaving an approximate free space of thirty-nine feet between the two lines.

The towers on this line are sixty-seven feet high. As will be seen from the photograph, Fig. 9, the design is somewhat different from the former towers and as already stated the three wires constituting a circuit are placed vertically one over the other (tandem). The lowest cross arm of this tower is twenty feet two inches in length from tip to tip. The upper arms are slightly shorter. It will also be noted that on account of the arrangement of the transmission cables three cross arms are necessary instead of the two used in the former design.

The insulator units are practically identical with the former type only slight changes being made in the hardware. The standard insulator contains eight units as before but the strain insulators consist of two parallel insulators of ten units each connected together and to the line at one end and the tower at the other by two yokes. A clearance of nine feet between conductors on the same circuit is maintained throughout.

The longest span is 780 feet and the average about 660 feet. All the footings are placed seven feet in the ground as before, but on the St. Thomas to Windsor line all strain towers have concrete footings.

Two circuits of No. 3/0 copper are being installed on this line and will be given five complete transpositions in the total distance. Two ground wires are installed on the two shoulders shown at the top of the tower. These are 5/16 galvanized steel.

The telephone line is standard construction using 30-foot poles, No. 9 B. & S. wire with transpositions every fifth pole.

Kent

There are two high tension transforming stations in connection with the recent extension of the 110,000 volt line from St. Thomas westward to Windsor. These stations are located, one in the neighbourhood of Chatham, the other close to Windsor. The first is known as the Kent station, the other, at the end of the line, as the Essex station.

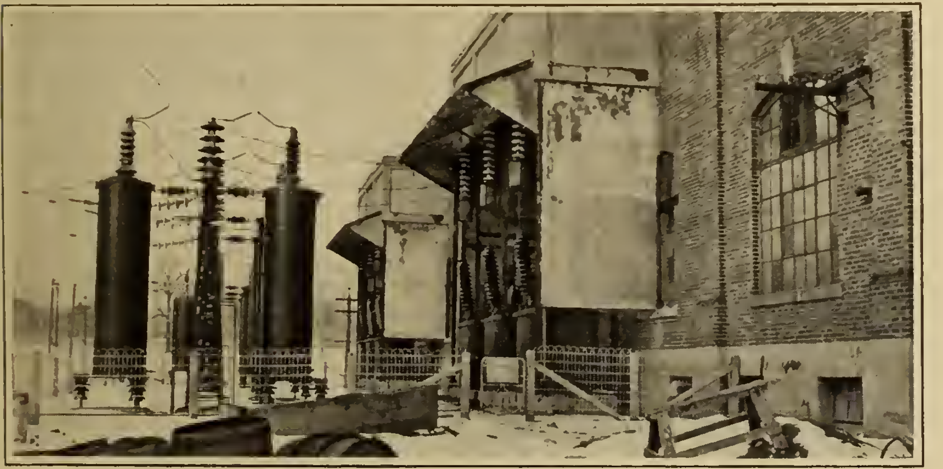


Fig. 20—Niagara Falls Station—High tension side.

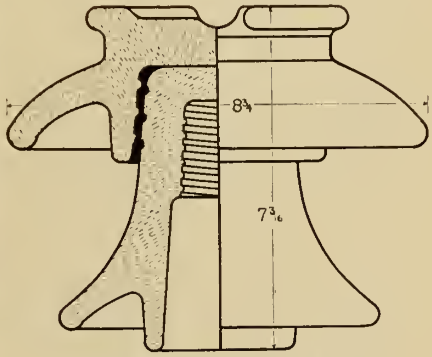


Fig. 22—Standard type 26,400 volt insulator.

The equipment installed in the Kent high tension station consists of four 1,250 kv.a. 110,000/26,400 volt oil-insulated, water-cooled transformers. These are connected in star on the high tension side and in delta on the low tension side.

The arrangement of the station is such that both 110,000 volt lines from St. Thomas enter the station and are connected through automatic oil circuit breakers to the main bus bars. The two outgoing lines which pass on to the Essex station are also provided with oil circuit breakers. Each of the two lines both on the incoming and outgoing sides is protected by an electrolytic lightning arrester.

The installation of the equipment in this station is not yet quite complete but there will be six 26,400 volt feeders to serve Chatham, Wallaceburg and other municipalities, which it is expected will use power in the near future, including Blenheim, Ridgetown, Thamesville, Bothwell and Dresden. Dresden will be supplied off the Wallaceburg line. Two extra 26,400 volt feeders will be required for the other service. The design of this station is shown in Fig. 11.

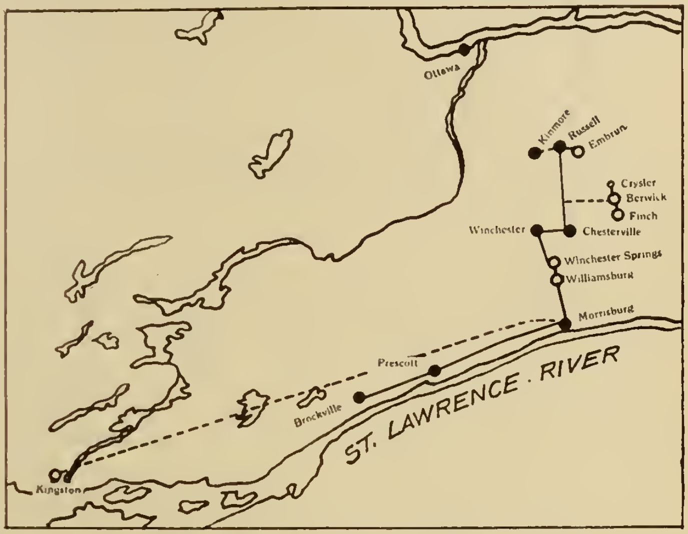


Fig. 21—Eastern section of Hydro distribution system.

Essex

The Essex station which has been erected at Wallaceburg, just outside Windsor, is the western terminus of the 110,000 volt line. It is being used to serve Walkerville, Windsor and Sandwich and will serve other and surrounding municipalities in the near future. Both the 110,000 volt lines enter this station passing through automatic oil circuit breakers to the bus bars. Electrolytic lightning arresters are installed as in the other stations. The transformer equipment consists of four 2,500 kv.a. single-phase, oil-insulated, water-cooled, transformers, three being connected in a bank in star on the high tension side and in delta on the secondary side. The fourth transformer will be kept as a spare. The secondary voltage is 26,400. Six 26,400 volt feeder lines and equipments are installed. The equipment was supplied by the Can-

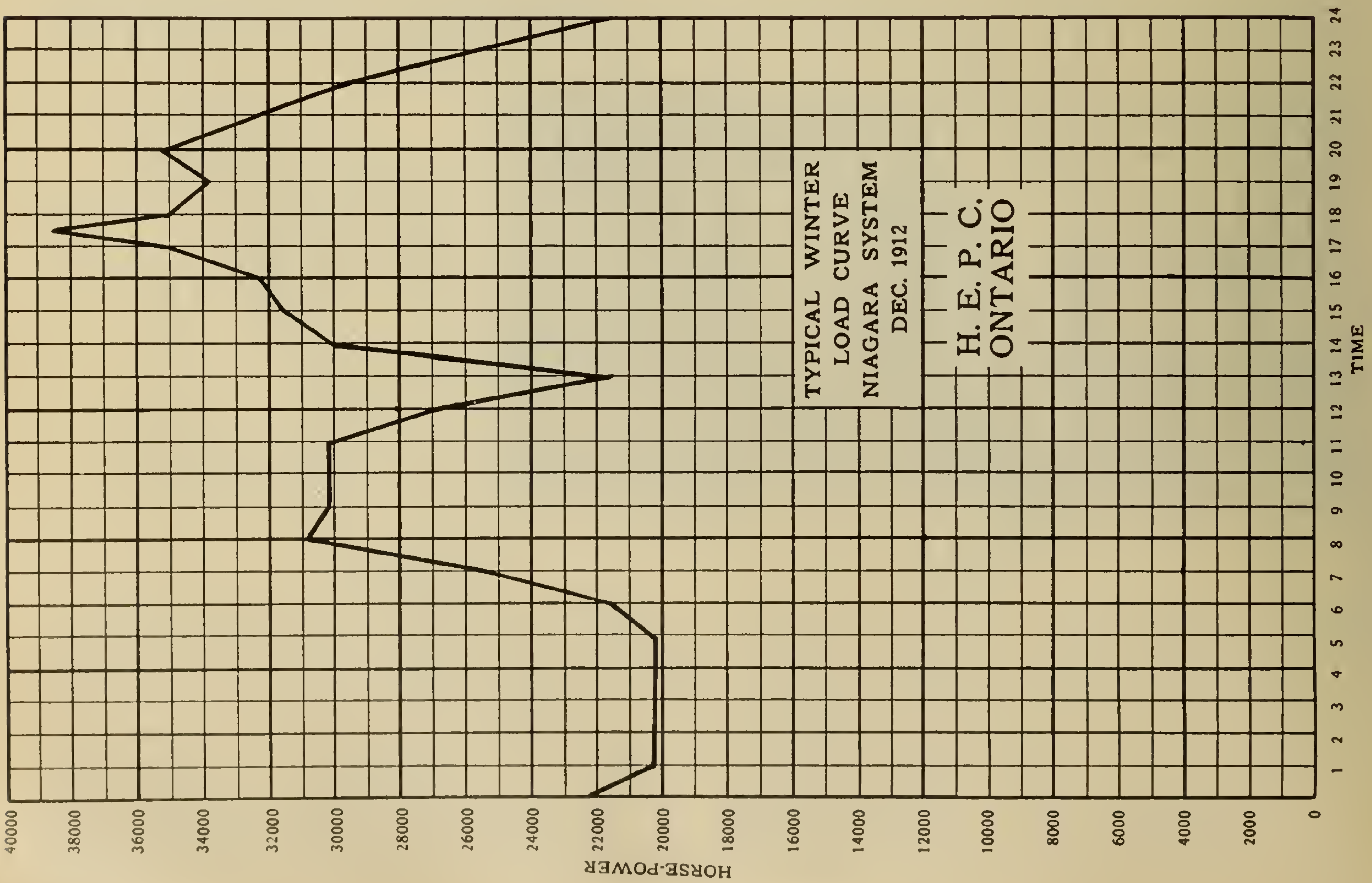


Fig. 23—Typical winter load curve, Niagara system.

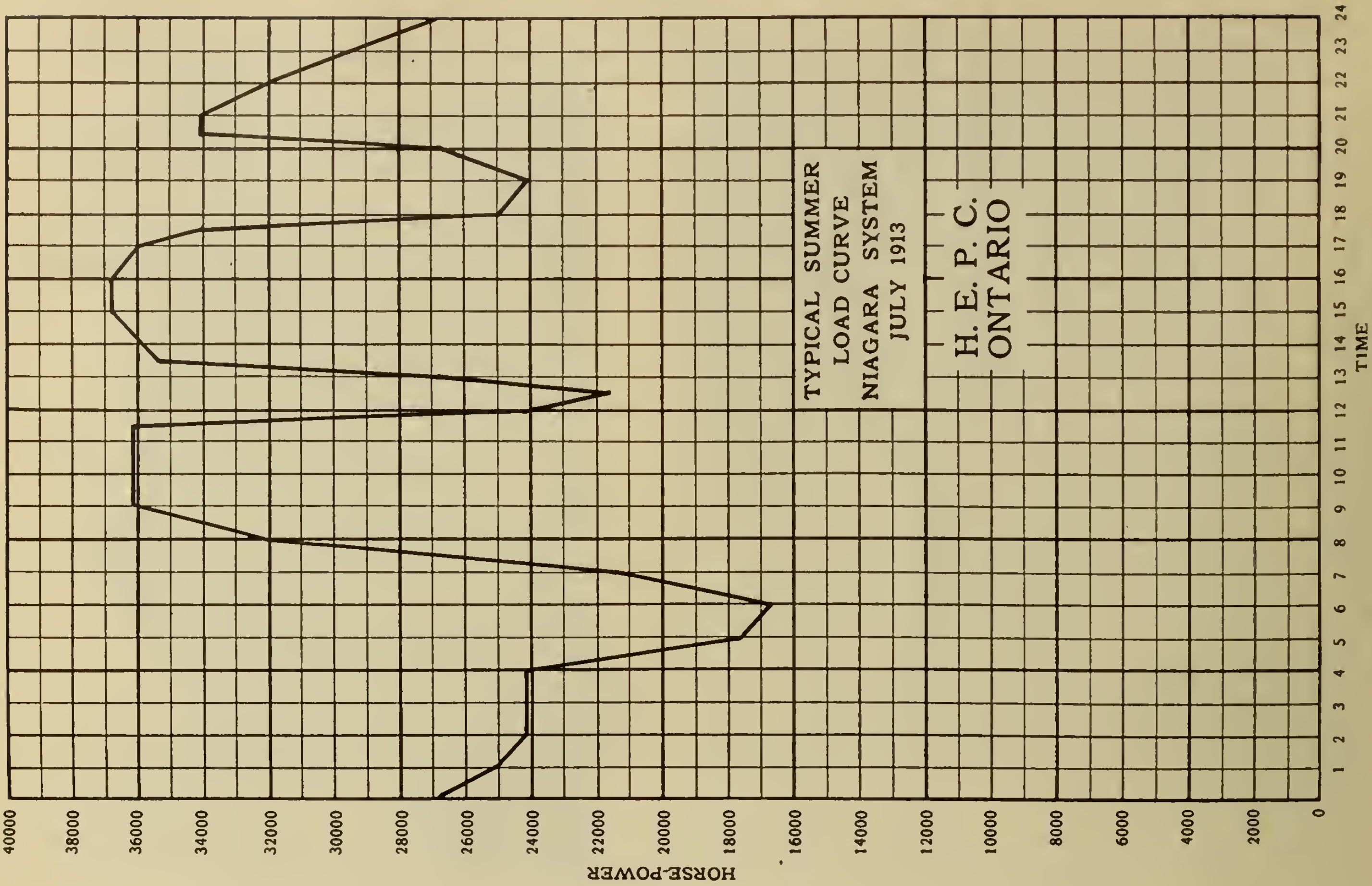


Fig. 24—Typical summer load curve, Niagara System.

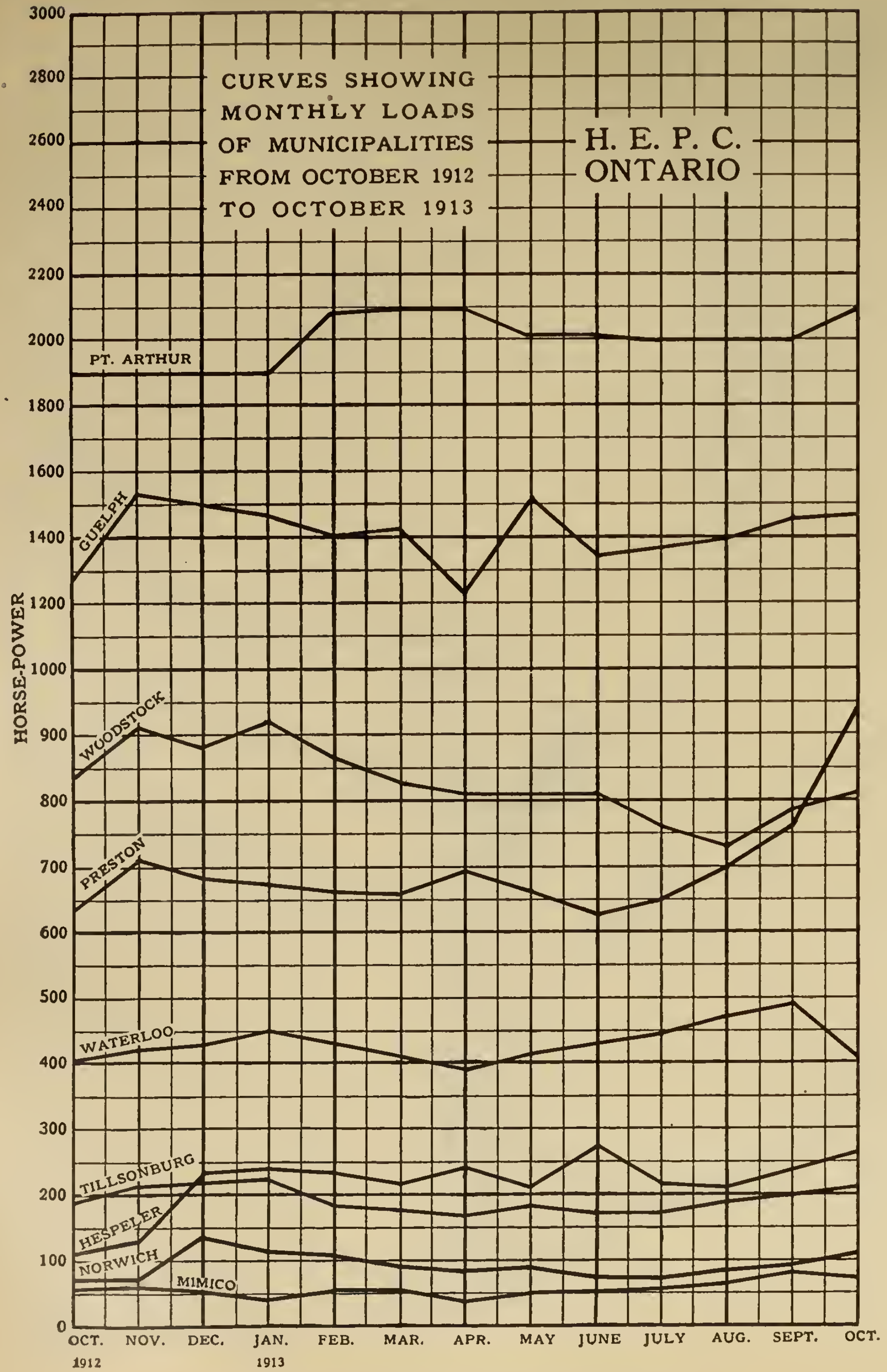


Fig. 25 Showing monthly load curves of different municipalities.

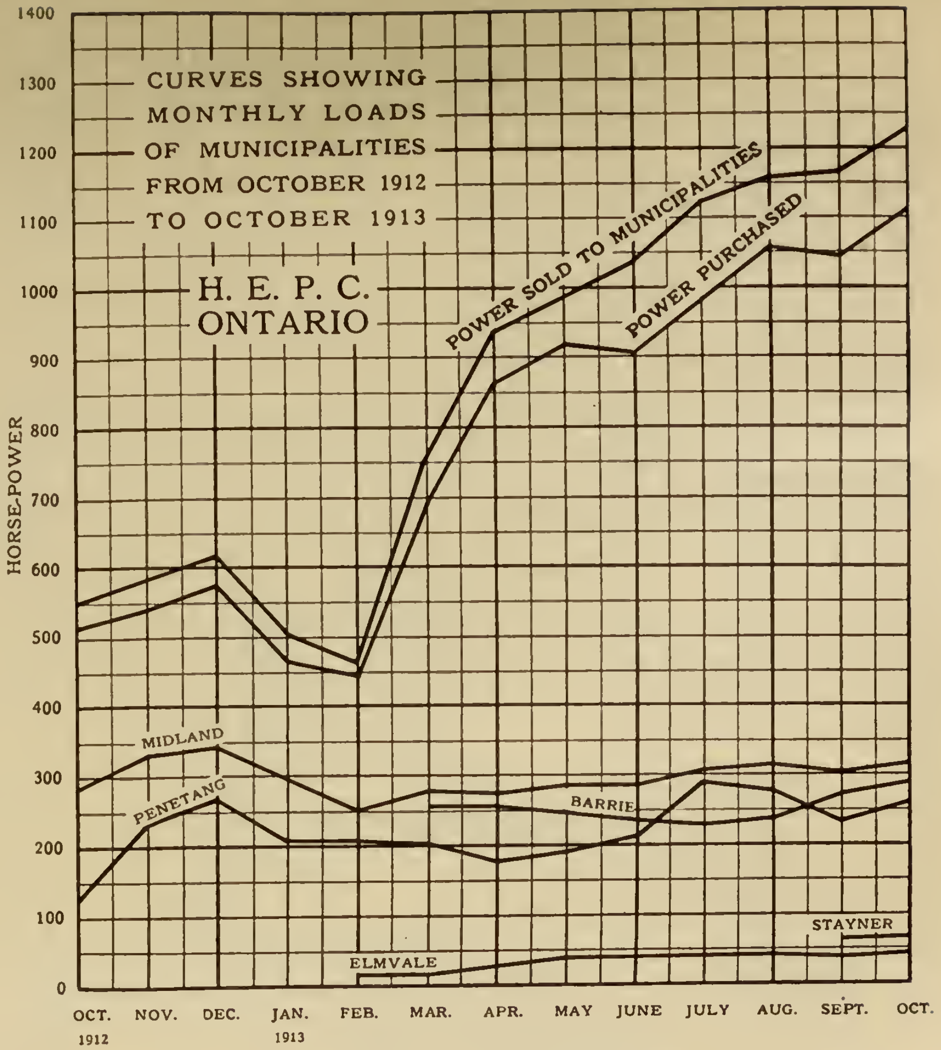


Fig. 26—Monthly load curves of municipalities.

Figs. 25 and 26 show the monthly load curves of a number of municipalities for the year ending October, 1913. The noticeable point is the overlapping of the load peaks. The maximum load has rarely been reached at the same time by any two municipalities. This affects the load factor of the system very favorably. It also enables the Commission to sell more power to the municipalities than they buy from the generating company. This is indicated by the two upper curves in Fig. 26, where it is seen that this gain has sometimes been in excess of 10 per cent.

adian Westinghouse Company. The general design of the station is shown in Fig. 16.

The Welland Line

A 46,000 volt, six circuit line is being installed at present between the Niagara Falls step-up station and the Welland district. This is a latticed steel tower line. The tower is 48 feet high over all, three feet square at the bottom and tapering to 1½ ft. square at the top. The towers carry four 4-pin cross arms and one 2-pin arm. The length of the 4-pin arm is 15 feet. These arms are spaced about four feet apart, the upper arm being two feet below the peak of the tower. The 2-pin arm is placed below the four 4-pin arms. The arms are of steel. The type of insulator used is a three unit suspension with four units in the strain insulators.

The footings of these towers are run seven feet into the ground and consist of an eight-foot block of concrete, i.e., seven feet underground and one foot above ground. The towers are spaced approximately 250 feet apart. One ground wire is installed on the peak of the tower line.

Six circuits are being installed to a distributing point in the neighborhood of Allenburg. From this point two circuits will be run to St. Catharines and four to the Union Carbide Company near Welland. The town of Welland will be supplied by a double line tapped off the line running to the Union Carbide Company, at the corner of Lincoln Street and Southworth Avenue.

Only a small portion of this line has yet been constructed but work is being pushed rapidly forward.

The Severn River System

On the 10th of February, 1911, the Hydro-electric Power Commission of Ontario entered into an agreement with the Simcoe Railway & Power Company to supply power under the following conditions:—for the initial 200 h.p. $21.00 per h.p. per annum; when the demand increased to 500 h.p. $20.00 per h.p. per annum; when the demand further increased to 1,000 h.p. $19.00 per h.p. per annum; when the demand increased to 1,500 h.p. $17.50 per h.p. per annum. This applied to delivery at 2,200 volts. If in any case the current is purchased at 22,000 volts the cost will be $1.00 less per h.p. per year.

The Simcoe Railway & Power Company have their own generating station at Big Chute. The design of this plant was described in detail in the January and February, 1913, numbers of the Electrical News. The plant is designed for five 900 kv.a. capacity 2,200 volt, 60-cycle, 3-phase, 300 r.p.m. generators. The turbines are double runner Francis type designed to develop 1,300 h.p. under a 56-foot head at 300 r.p.m. Power is generated at 2,200 volts and stepped up to 25,000 for transmission.

The power purchased from this company by the Commission is delivered to Port Severn, Waubaushene, Coldwater, Penetang, Midland, Elmvale, Barrie, Stayner, and Collingwood at 25,000 volts. A transmission line has also been constructed connecting the Big Chute plant with another plant at Ragged Rapids further up the Severn River and owned by the municipality of the town of Orillia. It is understood to be the intention of this municipality to replace the Ragged Rapids plant by another larger plant more advantageously situated both from the point of view of power development and in connection with the Trent Valley canal being constructed by the government.

The extent of this system is shown in the map, page 54 It will be seen from the dotted lines that ultimately it is the intention to connect the Big Chute plant with Wasdell's Falls on the east and Eugenia Falls on the west and through Eu-

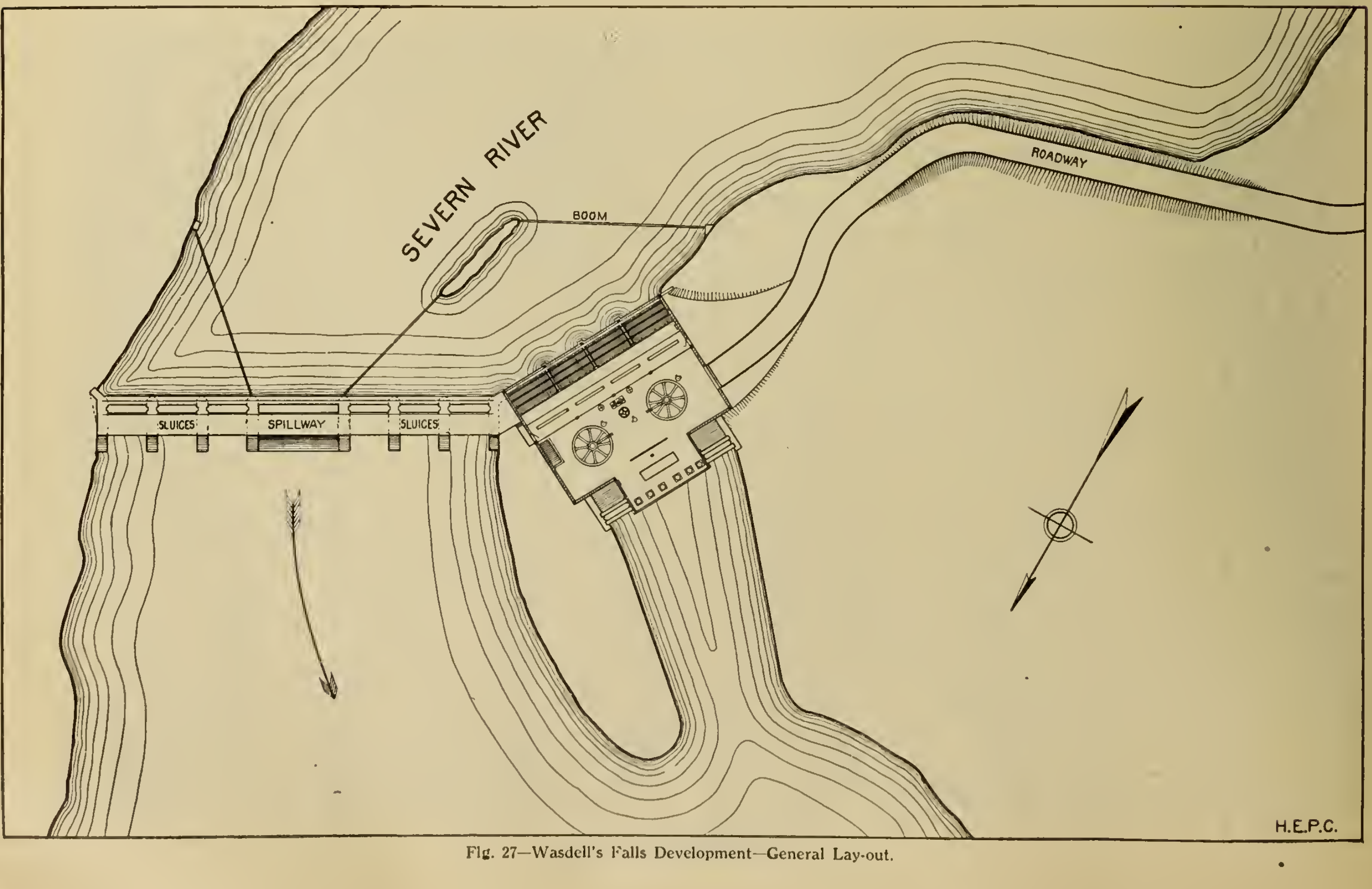


Fig. 27—Wasdell's Falls Development—General Lay-out.

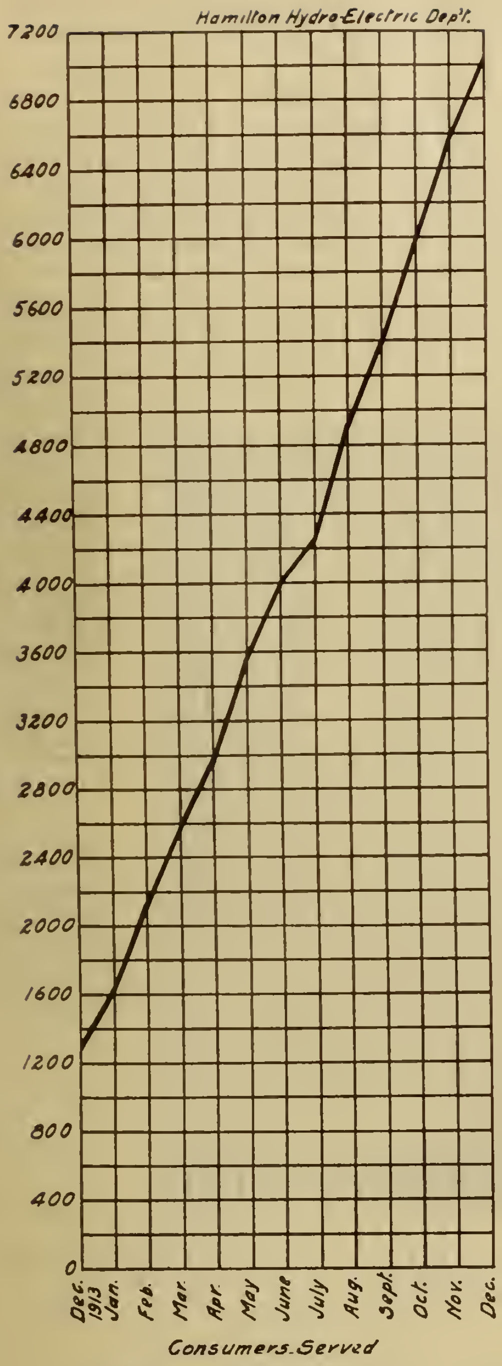


Fig. 28—Hamilton's prosperity curve.

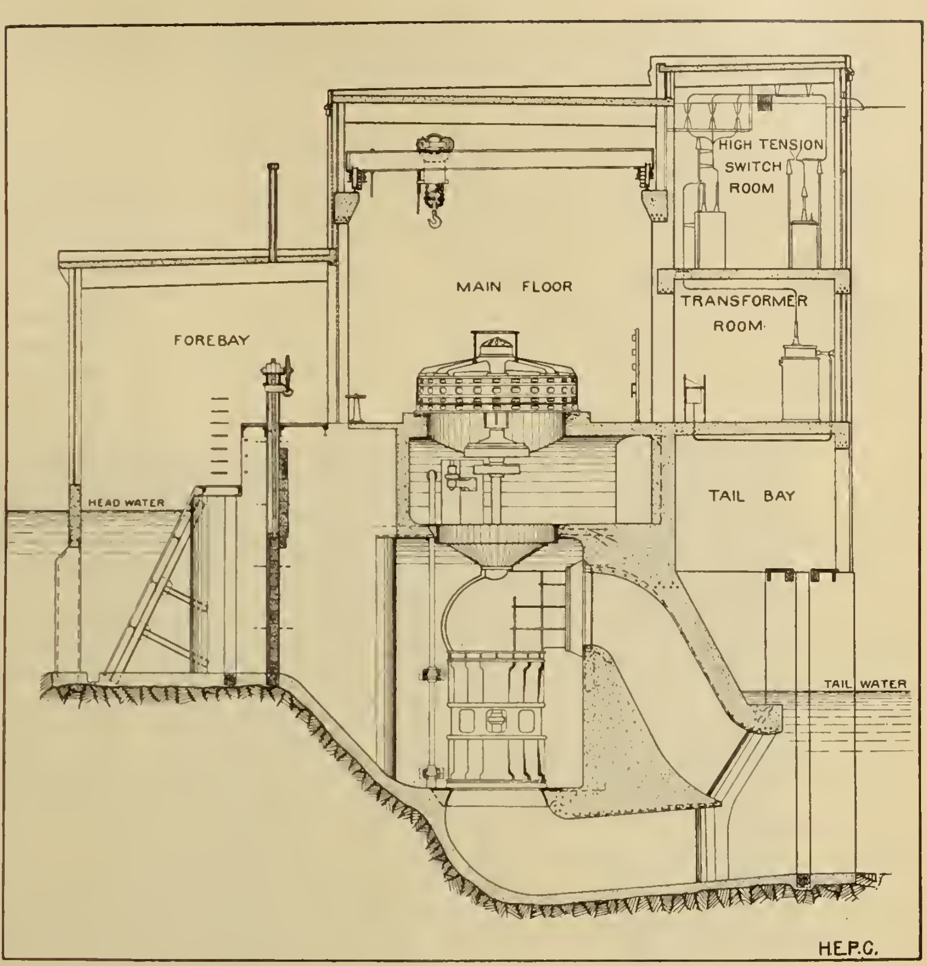


Fig. 29—Wasdell's Falls Development—Cross Section through Power House.

genia Falls with the most northerly section of the Niagara Falls system.

Up to the present time local transformer equipment for this system has been installed as follows:—Barrie 700 kv.a.; Penetang 600 kv.a.; Collingwood 750 kv.a.; Coldwater 225 kv.a.; Elmvale 255 kv.a.; Stayner 300 kv.a.

The original equipment in the Penetang station was 400 kv.a. but owing to increased demand for power another 200 kv.a. single-phase, 60-cycle, 2,300 volt unit was added during the past year.

The Barrie installation consists of two 350 kv.a. single-phase transformers and 22,000 volt switching and protective apparatus. The old power station of the town is being used to house the equipment. The town itself has purchased potential regulators and power and lighting feeder panels required on their local system. There has also been placed in service a motor driven pump equipment for both domestic and fire service.

In Collingwood three 250 kv.a. transformers have been installed with switching and protective equipment. The town has built a new power station and purchased potential regulators and a motor driven pumping equipment. The secondary system in Collingwood is 2,300 volts, three-phase.

Three 75 kv.a. transformers are installed in Coldwater for stepping down from 22,000 volts three-phase to 2,300 volts three-phase. There is also a full complement of protective devices.

In the village of Elmvale there is installed three 75 kv.a. single-phase transformers and switching equipment for one 22,000 volt incoming line and one 2,300 volt outgoing line. The 22,000 volt protective equipment was supplied by the Siemens Company of Canada. A new station was constructed which is practically a duplicate of the Coldwater station.

The equipment in Stayner consists of three 100 kv.a. transformers supplied by the Canadian Westinghouse Company. Siemens' lightning arresters and choke coils are installed for 22,000 volt protection. These transformers are star connected with neutral grounded so as to give 4,000 volt, three-phase distribution.

Wasdell's Falls Generating Station

The first point at which the Commission have undertaken to generate power by the development of a waterfall is at Wasdell's Falls on the Severn River, just where the river leaves Lake Couchiching, the northern arm of Lake Simcoe.

Specifications were issued in May, 1913, covering complete electrical equipment for development at this point, and the contracts were awarded both for generators and exciters to the Swedish General Electric Company. The turbines were supplied by the Boving Company of Canada; the stop log winch and head-gate lifting mechanism by William Kennedy & Sons of Owen Sound; the over head crane by W. D.

Beath & Son. The dam and power house were constructed by Galbraith & Cate, Montreal. The transformers and complete switching equipment are being supplied by the Canadian Westinghouse Company.

A description of the electrical equipment follows:—There are two vertical type 400 kv.a., 3-phase, 60-cycle, 2,300 volt, 90 r.p.m. generators, each direct connected through a flexible coupling with a water wheel and each provided with a ball thrust bearing at the top of the generator frame. This bearing carries only the weight of the generator rotating parts. These generators have a 25 per cent. overload guarantee and are also guaranteed to withstand a test of 180 per cent. of normal speed for fifteen minutes with full excitation; also a short circuit at the terminals for one minute with the same excitation without injury to any part.

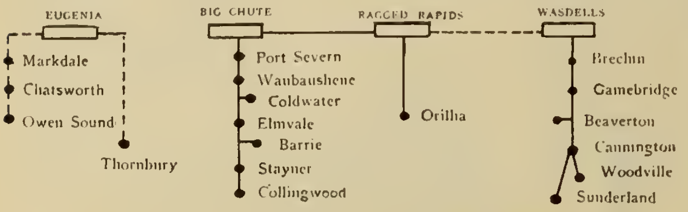


Fig 30—Towns served by Severn River and Eugenia.

Two compound wound, 125 volt, exciters are provided, one being turbine driven, and the other motor driven. The turbine driven exciter is rated at 20 kw., 190 r.p.m. and is capable of exciting both generators. The motor driven exciter is rated at 30 kw., 1,200 r.p.m. and is on the same base with and direct connected to a 45 h.p., 3-phase, 60-cycle, 220 volt squirrel cage induction motor. Both exciters are designed to be suitable for use with a Tirrill voltage regulator.

There are two banks of transformers, each consisting of three 150 kv.a. single-phase, self-cooled, oil-insulated units with high tension voltages of 22,000, 23,000, 24,000 and 25,000 volts, and with low tension voltages of 2,300, 2,200, 2,100, 2,000 and 1,900 volts. A spare transformer is also being supplied.

In addition to above transformers there are three 15 kv.a., 2,300/220-110 volt, single-phase service transformers for use in supplying the motor for driving the exciter and for station lighting.

The switchboard consists of seven panels of black slate, there being two generator panels, two exciter panels, one station service panel and two combined transformer and outgoing line panels. The 2,300 volt bus bars and oil switches are mounted on a separate framework, a short distance behind the panels. The two outgoing high tension transmission lines are controlled by Westinghouse automatic Type "E" 25,000 volt oil switches in the gallery, operated from the switchboard on the main floor. There is an aluminium cell lightning arrester installed for each of the two lines.

The scheme of connections is such that the station may be operated in two parts if required, since each bus is divided by disconnecting switches into two sections with one exciter, one generator, one bank of transformers and one transmission line on each section. The general design of the station is shown in Figs. 27 and 29. It will be noticed that the turbine is of the double runner type, vertical shaft. The present installation constitutes the total capacity of the fall. The head is 12 feet at maximum. It is the ultimate intention to connect this system up with the two other generating plants on the Severn River, namely the Big Chute and Ragged Rapids. The course to be followed by this connecting line has not yet been determined however. In the meantime power will be supplied to Woodville, Sutherland, Cannington, Beaverton, Gamebridge and Brechin, at each of which points there will be a small station to step the current down from 25,000 volts to 2,200 volts for local distribution.

Signed contracts have already been received from municipalities in this district covering a supply of 625 h.p.

Eugenia Falls

For some time past the Hydro-electric Commission have been endeavoring to work out a feasible scheme whereby electric power and light might be supplied to Owen Sound and the surrounding district. The best source of power in the neighbourhood has been located at Eugenia Falls on the Beaver River, which was owned until recently by the Georgian Bay Power Company.

Some delay in the negotiations between the town of Owen Sound and the Hydro Commission was caused by uncertainty of the minimum waterflow measurements of the Beaver River, and to this end a sharp crested weir was built at Eugenia Falls and a recorder employed for the purpose of making continuous flow measurements during the summer of 1913. The details of this investigation satisfied the commission and the town of Owen Sound that they were justified in entering into a mutual contract to supply 1,200 h.p. to the town of Owen Sound. The initial development will be approximately 4,000 h.p. in generating capacity, and the station will be planned for an ultimate 8,000 h.p. capacity. The head at this point will be the highest east of the Rocky Mountains, and in the neighbourhood of 550 feet.

Surveys have been made and excavation work is at present under way, looking to the completion of this plant early in the year 1915.

Morrisburg

An agreement has been entered into with the Rapids Power Company of Morrisburg for the supply of a quantity of power to be distributed by the Commission to different points in Eastern Ontario. Certain assistance was given this company with the purchase of the necessary stepping up transformer equipment to be installed in its generating station at Morrisburg, from which the current is sent out over the distributing lines at 26,400 volts. Power lines at this voltage have been constructed to Prescott and Brockville in a westerly direction and to a number of smaller towns due north of Morrisburg as far as Russell.

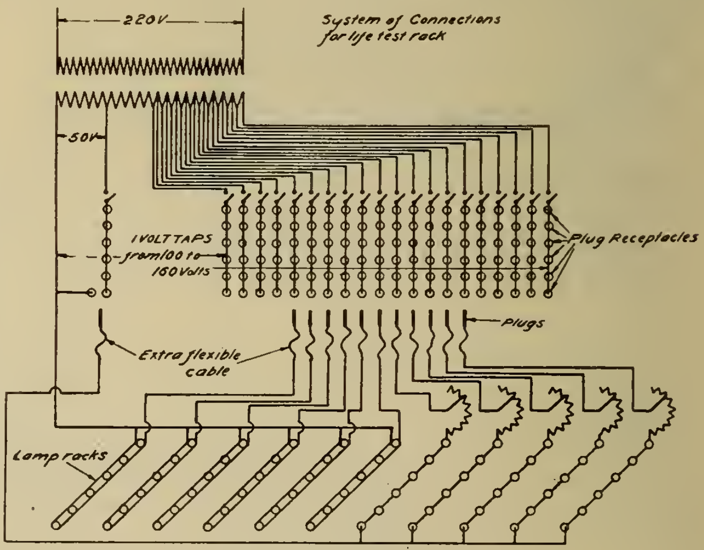

220V
System of Connections for life test rack
50V
1 VOLT TAPS from 100 to 160 Volts
Plug Receptacles
Plugs
Extra flexible cable
Lamp racks

Fig. 31—Lamp Testing Diagram, Toronto Laboratory.

In the Prescott station there are installed three 150 kv.a. single-phase transformers, stepping down from 26,400 to 2,300 volts; also switching equipment for one 26,400 volt line and two 2,300 volt feeders. The 26,400 volt protective equipment was supplied by the Siemens Company and the other electrical equipment was installed by the Canadian General Electric Company. The local distribution and street lighting system have been reconstructed. Prescott enjoys the distinction of being the first town to receive power through the Commission from a development on the St. Lawrence River.

Rates in Prescott

The rates in Prescott, which are typical for this district, are as follows:—Power rate: a service charge of $1.00 per month per h.p. of connected load or maximum demand plus a consumption charge of 2.8c per kw.h. for the first fifty hours' monthly use, 1.8c for the second fifty hours' monthly use and .2c per kw.h. for all additional consumption. A 10 per cent. discount for prompt payment is allowed.

For domestic lighting a service charge of 4c per 100 sq. ft. plus a consumption charge of 4c per kw.h. with 10 per cent for prompt payment is given. There is a minimum charge of 25c per month.

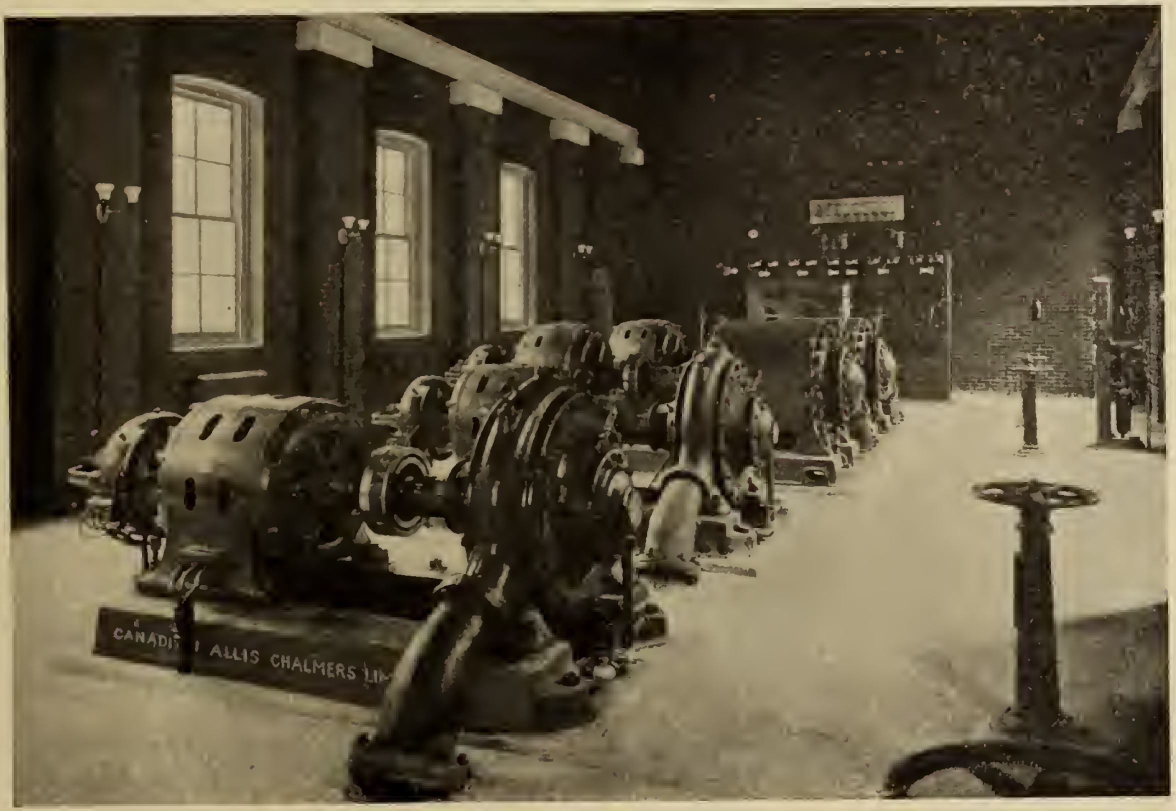


Fig. 32—Hamilton's Pumping Station.

For commercial lighting a rate of 8c per kw.h. is charged for the first 30 hours' use and 4c per kw.h. for all additional consumption with a prompt payment discount of 10 per cent. and a minimum charge of 50c.

The village of Winchester has signed an agreement with the Commission to take 100 h.p. at an estimated cost of $24.00 per h.p. per year. The by-law authorizing debentures for the necessary expenditures was carried by a vote of 154 to 4, which indicates the enthusiasm of that district over Hydro-electric power.

The village of Chesterville carried a $5,000 by-law by 111 to 21, and later signed a contract covering a supply of 50 h.p. at an estimated cost of $35.00 per h.p. per year.

An agreement with the town of Russell calls for the supply of 300 h.p. at an estimated cost of $33.87 per h.p. per year. The town has passed a by-law to expend $7,000.

Construction is well under way at all points where by-laws have been carried, and it is expected other towns and villages will be served in the near future. Reference to the map, Fig. 21 indicates the probable extent of the operations in this district in the near future. It will be noted that a projected line runs to Kingston. No contract has been closed as yet, but negotiations have been proceeding for sometime between the Commission and that city, and it is expected that some arrangements will be reached in the near future whereby Kingston can be served with power from the St. Lawrence River.

With the increased demands in this district it was evident that the supply available at the plant of the Rapids Power Company would soon be inadequate, and a contract has been closed by the Commission to obtain further supply from a plant at present under construction at Waddington Falls. The generating company agree to deliver the power to the national boundary, at which point the Commission will become responsible. It is believed that the power obtained in this way will be sufficient for sometime, and until some larger scheme of development of the St. Lawrence River has been decided upon.

Port Arthur

Power is purchased by the Ontario Commission from the Kaministiquia Power Company and supplied to the city of Port Arthur. The Commission constructed a 22,000 volt line and a 22,000/2,300 volt station and the original equipment had a capacity of 2250 kw. During the past year, however, work was completed on an additional section to the power house and the capacity is now 5,250 kv.a. including 2,200 volt service for commercial, street and house lighting, 600 volt lines for power service and a 750 kv.a. motor-generator set for street railway work.

Port Arthur has two local sub-stations and during the past year have erected a new pumping station in connection with the municipal waterworks plant.

The rate covering the purchase of power from the Kaministiquia Power Company is $16.00 which after transmission charges costs the municipality $19.50 for the amount now taken.

The extent of the transforming capacity installed and controlled by the Ontario Commission is given in detail in Table I. As indicating the rate at which capacity is being added, Table II. is a list of transformers purchased during the year ending October 31, 1913. It is to be understood that Table I. does not include purchases made by the municipalities, that is, for that class of station known as a "municipal station" defined earlier in this description. It refers only to high tension stations and "distributing" stations.

TABLE I.
TRANSFORMER STATION CAPACITIES

Niagara System	25 Cycle Voltage	Total Kv-A.
1. Niagara Transformer Station	12,000-110,000	52,500
	12,000- 46,000	21,000
2. Dundas Transformer Station	110,000- 13,200	7,500
Caledonia Dist. Station	13,200- 2,300	450
Waterdown Dist. Station	13,200- 2,300	225
Hagersville Dist. Station	13,200- 2,300	225
3. Toronto Transformer Station	110,000- 13,200	25,000
4. London Transformer Station	110,000- 13,200	5,000
Dorchester Dist. Station	13,200- 4,000	75
5. Guelph Transformer Station	110,000- 13,200	3,000
Acton Dist. Station	13,200- 2,300	225
Georgetown Dist. Station	13,200- 4,000	225
Rockwood Dist. Station	13,200- 2,300	75
6. Preston Transformer Station	110,000- 6,600	4,500
Breslau Dist. Station	6,600- 2,300	225
7. Berlin Transformer Station	110,000- 13,200	4,500
New Hamburg Dist. Station	13,200- 2,200	225
Baden Dist. Station	13,200- 2,300	225
Elmira Dist. Station	13,200- 4,000	225
8. Stratford Transformer Station	110,000- 13,200	3,000
	110,000- 26,400	5,000
9. St. Mary's Transformer Station	110,000- 13,200	3,000
St. Mary's Cement D.S.	13,200- 575	1,500
10. Woodstock Transformer Station	110,000- 13,200	3,000
Norwich Dist. Station	13,200- 2,300	150
Beachville Dist. Station	13,200- 2,300	150
11. St. Thomas Transformer Station	110,000- 13,200	3,000
Port Stanley Dist. Station	13,200- 2,300	150
12. Cooksville Transformer Station	110,000- 13,200	5,000
Mimico Dist. Station	13,200- 2,300	225
Port Credit Dist. Station	13,200- 2,300	225
Cooksville Dist. Station	13,200- 2,300	50
Streetsville Dist. Station	13,200- 4,000	225
13. Brant Transformer Station	110,000- 26,400	5,000
14. Kent Transformer Station	110,000 26,400	5,000
15. Essex Transformer Station	110,000- 26,400	10,000
		170,075
Severn System	60 Cycle	
Penetang District Station	22,000- 2,200	600
Barrie District Station	22,000- 2,300	700
Collingwood District Station	22,000- 2,300	750
Coldwater District Station	22,000- 2,300	225
Elmvale District Station	22,000- 2,300	225
Stayner District Station	22,000- 4,000	300
		2,800
St. Lawrence System		
Prescott Dist. Station	26,400- 2,300	450
		450
Port Arthur System		
Port Arthur Dist. Station	22,000- 2,200	5,250
		5,250
Wasdell's Falls System		
Power House	2,300/22,000	1,050
		1,050
Grand Total		179,625

The capacity of spare transformers is included in the above.

Ottawa

In Ottawa power is purchased by the Ontario Commission from the Ottawa & Hull Power Company which operates within the corporation limits. The rate paid to the Ottawa company is $15.00 per h.p. year.

The original contract was for 1,500 h.p. which was later increased to 2,500 and later to 4,000. At the present time negotiations are proceeding looking to an arrangement whereby a still greater quantity of power may be obtained for Ottawa. It has been thought that a separate plant may be installed by the Commission at Chats Falls but this matter is still held in abeyance pending the result of arbitration proceedings on the price of this power site. New consumers are being added in Ottawa at a very rapid rate. At December 31, 1913, Ottawa had 5,766 domestic light customers, 818 commercial light customers and 152 power customers

TABLE II.
STATION TRANSFORMERS PURCHASED
For Municipalities and Commission during fiscal year ending Oct. 31, 1913

Station	Frequency	Voltage	No.	Capacity	Total Kv-A.
Niagara Falls Trans. Stat.	25	12,000/110,000	3	3,500	10,500
	25	12,000/ 46,000	6	3,500	21,000
Dundas Transforming Stat.					
Corporation of Dundas...	25	13,200/2,300/575	3	150	450
Hagersville Dist. Station.	25	13,200/2,300/575	3	75	225
Toronto Transforming Stat.	25	110,000/13,200	3	2,500	7,500
Guelph Transforming Station.					
Central Prison Farm ...	25	13,200/2,300/575	3	100	300
Georgetown Dist. Station.	25	13,200/2,300/575	3	75	225
Rockwood Dist. Station..	25	13,200/2,300/575	3	25	75
Preston Transforming Stat.					
Corporation of Preston..	25	13,200/2,200	3	170	510
Corporation of Galt	25	13,200/2,200	3	150	450
Breslau Dist. Station ...	25	13,200/2,200	3	75	225
Berlin Transforming Stat.					
Corporation of Berlin....	25	13,200/2,200	3	250	750
Elmira Dist. Station ...	25	13,200/2,200	3	75	225
Baden Dist. Station	25	13,200/2,200	3	75	225
Stratford Transforming Stat.	25	110,000/26,400	4	1,250	5,000
Corporation of Clinton ..	25	26,400/2,300/575	3	150	450
Corporation of Goderich.	25	26,400/2,300/575	3	250	750
London Transforming Stat.					
Dorchester Dist. Station.	25	13,200/2,300/575	3	25	75
St. Thomas Trans. Station.					
Corporation of St. Thomas.	25	13,200/2,300/575	3	100	300
Corporation of St Thomas.	25	13,200/2,300/575	3	150	450
Cooksville Trans. Station.					
Corporation of Milton...	25	13,200/2,300/575	3	250	750
Streetsville Dist. Station.	25	13,200/2,300/575	3	75	225
Brant Transforming Station.	25	110,000/26,400	4	1,250	5,000
Corporation of Brantford.	25	26,400/2,300/575	2	750	1,500
Corporation of Paris	25	26,400/2,300/575	3	200	600
Kent Transforming Station.	25	110,000/26,400	4	1,250	5,000
Essex Transforming Station	25	110,000/26,400	4	2,500	10,000
Penetanguishene Dist. Stat..	60	22,000/2,200	1	200	200
Elmvale Dist. Station	60	22,000/2,300	3	75	225
Stayner Dist. Station.	60	22,000/2,300	3	100	300
Wasdell's Falls Power Stat.	60	2,300/22,000	7	150	1,050
Prescott Dist. Station	60	26,400/2,300/575	3	100	300
Total					74,835

Hydro in Preston

(Contributed)

The electric business of the Town of Preston is managed by the Preston Light & Water Commission. In 1910 work was commenced to put the system in shape to handle hydro-electric power. Improvements and extensions have been made yearly since and during this time $62,000 has been spent on capital account. Our maximum demand of power purchased from the Hydro Commission is 951 h.p., and our original contract with the hydro was for 600 h.p. with the privilege of reducing to 300 h.p.

In 1910 we installed three 170 kva. station transformers and in 1913 we duplicated the transformer capacity of the station. We serve power to 29 customers with a maximum demand of 1120 h.p. At the present time we have 695 lighting customers. This is an increase of 401 since hydro was installed, and 200 of the increase were installed in 1913. The number of lighting customers is steadily increasing.

Rates are as follows:—

Power rates: $1.00 per h.p. per month and 2.3c, 1.6c and .2c less hydro standard class discounts and a prompt payment discount of 20 per cent.

Commercial lighting: 8c for first 30 hours' use of installed capacity and 4c additional less prompt payment discount of 20 per cent.

Domestic lighting:4c per 100 sq. ft. of area lighted and 4c per kw.h. less prompt payment discount of 20 per cent.

Street lighting: $12.00 per year for 100 watt lamp; $11.00 per year for 50 watt lamp.

We pump our water by centrifugal pumps operated by electricity which costs us 60 per cent. of what steam power would cost. Lamps are sold by us to the consumer at 10 per cent. above cost. Hydro electric power is popular with the people of Preston. Our population is 5,000.

During the year a 6,600 volt line has been installed to serve the Doon Twines, Limited, Doon. This line was built by the Ontario Commission but later taken over and is now operated by the local commission.

Commercial Development and Success

The success of the commercial side of this great enterprise is indicated by the tremendous extension of the past twelve months which aggregates some 75,000 kv.a. capacity in transformers of all sizes, Table II. The actual growth in demand during the last three and a half years is also indicated in a very definite manner by the chart in Fig. 33 which indicates the rapid increase of the total power consumption of the various municipalities served by the Ontario Commission.

This figure starts with May, 1911, when the power load was approximately 8,000 h.p. In one year this had increased to 20,000 h.p., in two years it had reached about 38,000 h.p. and during the peak of the past winter, which occurred in December, 1913, a total of 48,614 h.p. was reached.

The slight fall in the total power consumption following the peak load of December in both 1912 and 1913 is easily accounted for by the increased amount of daylight and the consequent smaller consumption of power for lighting purposes.

TABLE III.

Municipality	Load in h.p. Oct. 1912	Load in h.p Oct. 1913
Toronto	13036.5	17997.5
London	2681	3385
Guelph	1273.5	1488
Stratford	643.5	791
Mitchell	221	201
St. Thomas	643.5	1173
Woodstock	837.5	808.5
Ingersoll	496	469
Tillsonburg	194.5	208
Berlin	1226.5	1434.5
Waterloo	402	409
New Hamburg	107	153
Preston	643.5	931.5
Galt	643.5	1025.5
Hespeler	107	254.5
St. Mary's	261	368.5
Dundas	127.5	268
Hamilton	2044	3639.5
Hamilton Asylum	87	80.5
Weston	100.5	151.5
Brampton	382	474.5
Norwich	67	104.5
Seaforth	174	214.5
Waterdown	40	41.5
Ontario Agricultural College	114	129
London Asylum	67	120
Pt. Stanley	40	73
Baden	13.5	165
Mimico	50	71
Beachville	27	100.5
Pt. Credit	24	33.5
Caledonia	13.5	32

As indicating the load increases throughout the Niagara system, Table III., is interesting. It gives the h.p. load of a number of municipalities on October, 1912, and one year later on October, 1913. The increase is a very substantial one in practically every case and in some instances the load is more than doubled. Since that date the increases have been of about the same order.

Total Cost of System

The last financial report issued by the Commission gives the total capital expenditures on the different distribution systems up to October 31, 1913. These are as follows:—Niagara, $5,190,858.98; Port Arthur, $90,425.26; Morrisburg system, $93,666.02; Severn system, including Wasdell's Falls development, $250,099.48; sundries, $290,674.87; grand total, $5,915,724.51. Since that date, however, work has been vigorously pushed forward and the total expenditure either incurred or contracted for is now somewhere between $7,500,000 and $8,000,000.

It is to be understood, too, that this is the expenditure of the Commission alone. As already indicated the towns and cities purchase their own equipment and build their own sub-stations, only the villages being financed by the Provincial Commission.

The expenditures of the forty-five largest municipalities up to December 31, 1913, which covers practically the whole expenditure to that date total $9,119,008.59. Interesting figures are given in this connection in Table IV., which shows the plant cost, debentures and over draft, operation and maintenance, fixed charges, revenue, surplus, depreciation, number of customers, etc., up to the end of 1913. It will be seen that Toronto has made by far the largest expenditure, their total being $4,569,620.90. Ottawa comes next with nearly three-quarters of a million, London next with well over half a million, Hamilton and Port Arthur practically the same, Berlin over quarter of a million, and a half dozen other places well over the hundred thousand mark. It is interesting to note that the total number of customers of all kinds served by these forty-five municipalities at date December 31, 1913, was 65,697.

The Rates

The rates charged the different municipalities by the Commission and the rates charged consumers by the municipalities are possibly the most interesting features of the whole hydro-electric scheme. Table V. gives information with reference to municipal street lighting showing the cost of arc lights, the cost of incandescents and in the last column the cost per head of population per year of the street lighting. This has only been worked out for about half of the municipalities but sufficient data is given in this

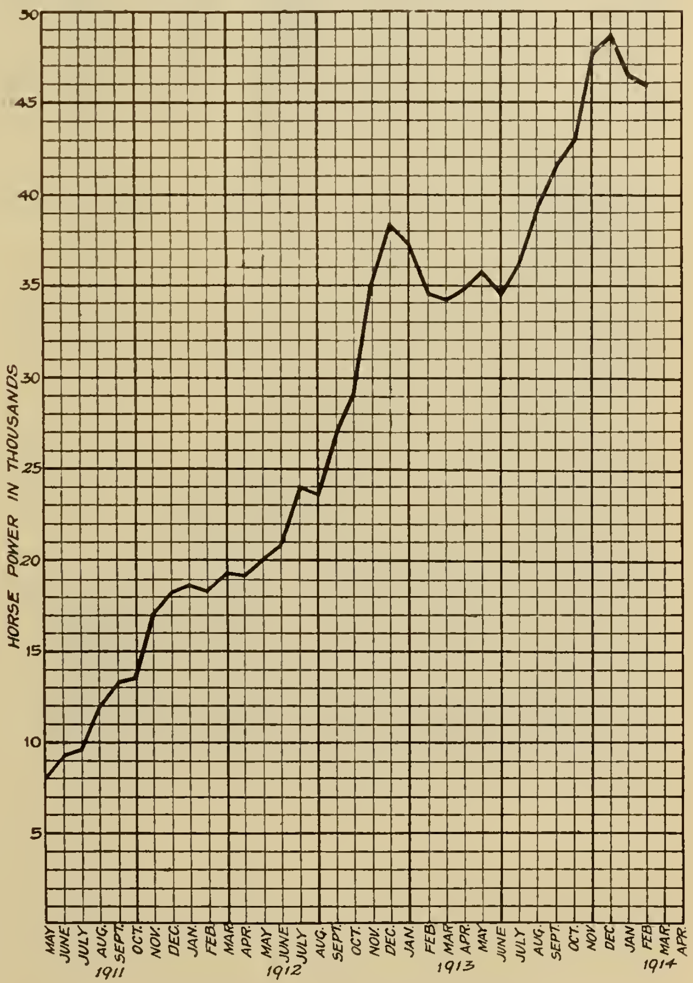


Fig. 33. Showing increase in total load on the Niagara system.

TABLE IV.

Municipality.	Plant Cost	Debentures and Overdraft	Operation and Maintenance	Fixed Charges	Total Operation	Revenue.	Gross Surplus	Depreciation	Net Surplus	Number of Customers			
										House	Comm'l	Power	Total
	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.				
Toronto................(a)	3,919,809 80	5,149,803 65	670,082 78	239,951 08	910,033 86	1,151,128 89	241,095 03	(h)91,819 92	149,275 11	16,519	4,764	1,037	22,320
Ottawa....................	703,122 64	500,000 00	111,322 00	30,961 54	142,283 54	191,648 64	49,365 10	24,000 00	25,365 10	5,766	829	141	6,736
Hamilton..............(a)	546,437 11	486,468 13	74,514 40	17,416 18	91,930 58	110,496 42	18,565 84	(k) 8,597 09	9,968 75	5,117	924	209	6,250
London....................	590,769 16	481,900 00	126,323 86	28,831 47	155,155 33	192,224 47	37,069 14	21,716 32	15,352 82	5,201	1,007	198	6,406
Berlin.................(g)	267,225 80	257,659 13	51,292 70	17,897 45	69,190 15	94,555 19	25,365 04	10,980 79	14,384 25	1,291	470	127	1,888
Port Arthur............(a)	545,902 57	496,500 00	68,282 71	38,409 37	106,692 08	171,514 02	64,821 94	(b)	64,821 94	3,409	500	55	3,964
St. Thomas................	143,263 93	94,039 74	41,561 36	7,402 65	48,964 01	75,124 04	26,160 03	6,900 00	19,260 03	951	329	70	1,350
Guelph....................	153,453 06	119,084 02	47,294 58	10,273 27	57,567 85	80,726 82	23,158 97	8,000 00	15,158 97	1,260	400	85	1,745
Stratford.................	163,431 50	121,663 83	31,808 58	10,536 75	42,345 33	55,983 70	13,638 35	3,420 00	10,218 35	1,084	367	92	1,543
Galt......................	181,124 22	151,084 42	23,563 01	9,721 64	33,284 65	45,233 73	11,949 08	8,400 00	3,549 08	1,122	353	65	1,540
Woodstock.................	132,354 04	78,527 12	28,598 86	6,853 83	35,452 69	46,859 86	11,407 17	5,827 40	5,579 77	636	282	55	973
Collingwood...............	52,534 04	37,950 42	13,492 17	4,277 77	17,759 94	21,181 64	3,411 70	2,390 00	1,021 70	477	220	18	715
Barrie....................	98,905 03	55,755 06	17,540 63	5,590 40	23,131 03	27,245 02	4,113 99	3,350 00	763 99	763	200	13	976
Welland...................	70,944 83	64,016 63	6,560 53	711 19	7,371 72	7,630 34	258 62	(c)	258 62	408	53	18	479
Ingersoll.................	87,864 29	75,135 90	16,313 16	5,337 25	21,650 41	30,176 00	8,525 59	2,862 00	5,663 59	278	170	44	492
Midland...................	72,476 09	42,997 23	9,289 07	4,134 55	13,423 62	21,362 56	7,938 94	2,950 00	4,988 94	491	172	25	688
Waterloo...............(g)	77,121 17	53,507 14	17,830 01	3,675 97	21,505 98	29,626 32	8,120 34	3,100 00	5,020 34	321	125	44	490
Dundas....................	49,549 90	48,055 62	6,001 12	1,970 14	7,971 25	11,300 43	3,329 17	1,508 00	1,821 17	377	134	27	538
Preston...................	90,619 88	77,157 29	21,468 32	4,120 54	25,588 86	34,688 57	9,099 71	2,924 00	6,175 71	526	151	28	705
Penetang..................	41,031 38	29,490 67	9,319 95	2,035 90	11,355 85	17,318 91	5,963 06	1,820 00	4,143 06	128	91	15	234
St. Mary's................	64,415 89	49,555 89	14,183 25	4,616 15	18,799 40	20,173 22	1,373 82	3,200 00	(d)*1,826 18*	396	160	29	585
Brampton..................	61,005 66	67,793 85	13,934 43	3,781 62	17,716 05	23,661 98	5,945 93	2,500 00	3,445 93	643	138	16	797
Tillsonburg...............	36,573 97	34,971 45	10,247 52	2,137 07	12,384 59	16,001 19	3,616 60	1,782 75	1,833 85	254	143	17	414
Hespeler..................	29,134 71	30,019 91	9,018 45	2,140 19	11,158 64	10,418 05	(e) *740 59*	1,450 00	(d)*2,190 59*	174	76	11	261
Seaforth..................	23,537 49	24,090 67	10,190 52	1,653 65	11,845 17	14,388 08	2,542 91	1,300 00	1,242 91	178	105	10	293
Weston....................	29,135 16	18,626 50	7,531 92	1,588 48	9,120 40	13,836 79	4,716 39	1,390 00	3,326 39	360	34	6	400
Milton....................	24,177 73	23,145 10	5,112 43	1,582 93	6,695 36	9,867 10	3,171 74	900 00	2,271 74	110	74	5	189
Mitchell..................	27,103 21	11,684 02	8,320 90	2,224 07	10,544 97	13,459 54	2,914 57	1,150 00	1,764 57	179	85	16	280
Georgetown................	18,014 48	20,000 00	972 91	484 33	1,457 24	2,280 35	823 11	300 00	523 11	160	120	5	285
Acton.....................	10,935 05	10,748 00	3,022 37	1,124 06	4,146 43	4,409 45	263 04	500 00	(d) *236 96*	82	62	3	147
New Hamburg...............	23,727 21	17,751 94	6,724 08	1,170 92	7,895 00	11,424 57	3,529 57	900 00	2,629 57	142	63	8	213
Mimico....................	15,607 08	14,685 80	2,174 95	845 02	3,019 97	3,803 55	783 58	740 00	43 58	250	....	5	255
Port Dalhousie............	11,043 46	11,957 44	3,970 83	814 89	4,785 72	5,336 49	550 77	450 00	100 77	238	....	3	241
Norwich...................	14,285 41	14,467 36	4,272 92	886 40	5,159 32	6,400 52	1,241 20	500 00	741 20	166	76	3	245
Hagersville...............	6,558 31	6,000 00	1,004 93	97 60	1,102 52	1,128 77	26 25	(c)	26 25	3	24	3	30
Baden.....................	5,540 63	4,843 68	3,103 33	325 26	3,428 59	3,957 83	529 24	277 00	252 24	75	....	2	77
Stayner...................	10,018 67	8,755 34	202 00	340 82	542 82	612 25	69 43	(c)	59 43	120	30	2	152
Caledonia.................	4,871 81	4,410,95	783 78	328 09	1,111 88	1,458 94	347 06	250 00	97 06	17	16	1	34
Coldwater.................	7,710 77	7,000 00	544 86	455 36	1,100 22	1,514 87	414 65	350 00	54 55	48	32	2	82
Port Stanley..............	19,642 58	18,153 58	4,522 20	1,188 91	5,711 11	8,217 86	2,506 75	617 75	1,889 00	182	60	9	251
Elmvale...................	7,423 01	6,894 64	589 31	299 76	889 07	933 65	44 58	(c)	44 58	52	52	1	105
Waterdown.................	7,373 96	6,303 41	1,420 16	521 56	1,941 72	2,516 94	575 22	365 00	210 22	70	34	2	106
Rockwood..................	5,526 51	5,034 13	281 96	225 99	507 95	907 09	399 14	(c)	399 14	48	9	1	58
Beachville................	8,361 27	5,360 00	4,729 51	518 86	5,248 37	6,762 21	1,513 84	525 00	988 84	45	....	4	49
Port Credit...............	9,533 02	7,268 55	1,525 95	534 23	2,050 18	3,507 81	1,447 63	446 00	1,001 63	93	21	2	116

Figures in italics denote credits. a; Does not include old plant account. b, c and d; No depreciation included. e; Conditions now improved. f; Full depreciation not allowed. g; Thirteen months. h; Depreciation at 2½ per cent. k; Depreciation 3 per cent.

table to indicate the satisfactory cost of street lighting in general over this system. No figures are available on the operation of the new magnetite arc lamp and it will be interesting to see the effect of this type, as also of the nitrogen filled tungsten, on the cost of operation per head.

Power Rates

As far as possible the power rates all over the hydro system have been standardized. There is, first, a service charge of $1.00 (generally) per month per h.p. of connected load or maximum demand. In the determination of what the maximum demand shall be in any particular case a considerable amount of latitude is necessarily allowed. It depends on the particular system followed by any municipality and it will depend, of course, on the particular installation, as, for example, in a woodworking plant where there may be a dozen individual motors aggregating say 100 h.p. and where perhaps only half of these are operating at any one time, it will be manifestly unfair to consider the maximum demand as equal to the connected load. This figure of the maximum demand having been determined, however, a practically uniform system of charging has been adopted. The maximum demand in a case like the above may be placed at 50 h.p. or less. In the larger municipalities this figure is generally arrived at by periodic tests, but the smaller municipalities are necessarily governed by past experience and by the good judgment of the superintendents and engineers in charge aided by such data as is available bearing on their special conditions.

In addition to the service charge there is a consumption charge (based on the meter reading) at a certain fixed rate for the first fifty hours' use of this maximum demand, a second and smaller rate for the consumption during the second fifty hours' use of this load, and a third and still smaller rate (usually very small) for all consumption over this amount. These rates vary, of course, with the different municipalities. Varying discounts are also given off the above charges depending upon the "class" of service to which the customer belongs. Class A means twenty-four hours unrestricted use of connected load or maximum demand, on which there is no class discount. Class B means twenty-four hours' restricted use on which there is a 10 per cent. class discount (the restricted hours are given below). Class C means 10 hours' unrestricted use on which there is a 10 per cent. class discount; and class D means ten hours' restricted use on which there is a 33 1/3 per cent class discount. The restricted hours are as follows:—October 15 to 31, 5.30 to 6.30 p.m.; November 1 to 30, 5.00 to 6.30 p.m.; December 1 to January 15, 4.30 to 6.30 p.m.; January 16 to February 15, 5.00 to 6.30 p.m.; February 16 to March 1, 5.30 to 6.30 p.m. A final discount for prompt payment is given on the total bill, the percentage depending on local conditions.

For example, take the case of Barrie. A power consumer pays a service charge per h.p. per month of $1.00 on his maximum demand load. He also pays for the first fifty hours' use of his maximum load at the rate of 3.6c per kw.h., and for the second fifty hours use 2.4c per kw.h., and for all additional .3c per kw.h. A 10 per cent discount is allowed off the total bill. We will suppose that the customer has a 10 h.p. maximum demand and that in any month his meter reads 1,400 kw. His bill would be as follows:—Service charge = $10.00; first fifty hours' use would cost 10 x ¾ x 50 x 3.6 = $13.50; second fifty hours' use would cost 10 x ¾ x 50 x 2.4 = $9.00; additional power 650 kw. at .3c = $1.95; total $34.45. If the customer were in the unrestricted twenty-four hour class he would get only a 10 per cent. discount for prompt payment making his bill $31.00. If he were in the twenty-four hour restricted class he would get 10 per cent. and 10 per cent. off, making his bill $27.90. In class C his bill would be the same as in class B. In class D his discount is 33 1/3 per cent. and 10 per cent. making his bill $19.68.

Commercial Lighting Rates

The rate for charging for commercial lighting has also been standardized as far as possible. For the most part, a certain rate is given for the first thirty hours per month of installed capacity with a lower rate for all current used in excess. There are a few exceptions as for example Dundas which gives a certain rate for the first twenty-five hours use, another rate for the next seventy-five hours use and a third and very low rate for all in excess. Over the total area the first rate varies from 12c down to 6c for the different municipalities. The secondary rate varies from 6c down to 2c. The discounts vary from 10 per cent to 25 per cent. A list of commercial rates as at date December 31, 1913, is given in Table VI.

Table V.

	Estimated population	Street lt. revenue	No. arcs	No. incandescents	Cost per arc per year	Cost per incandescent per year	Cost per capita per year
Toronto . .	435,000	344,933.79	....	38200	....	100w. 9.00	.80
Ottawa . . .	95,600	43,199.57	690	2460	45	100w. 6.83	.45
				186		100w. 10.00	
						75w. 11.00	
London. . .	52,000	28,372.20	....	2868	....	100w. 12.85	.54
St. Thomas .	17,000	10,989.72	44	1200	55	9.00	.64
						60w. 5.00	
Port Arthur .	15,600	14,709.41	....	2147	....	100w. 8.30	.94
Berlin . . .	17,500	16,057.40	....	1756	....	100w. 9.11	.91
Guelph . . .	16,319	9,500.04	....	1000	....	100w. 9.50	.59
Galt	11,800	6,280.25	....	901	....	100w. 9.50	.54
				38		250w. 25.00	
Woodstock. .	10,154	7,160.00	....	655	....	100w. 10.00	.70
Collingwood .	7,600	3,802.84	....	385	....	12 00	.50
						80w. 12.50	
Ingersoll . .	5,149	4,262.03	....	323	....	60w. 12.00	.82
Midland. . .	6,200	3,463.07	16	220	50	100w. 13.50	.52
						100w. 10.00	
Waterloo . .	7,000	4,877.64	....	546	....	60w. 9.00	.70
						100w. 12.00	
Preston . . .	4,982	2,594.55	....	234	....	50w. 11.00	.52
Penetang . .	3,701	2,042.00	....	161	....	100w. 12.00	.55
St. Mary's. .	4,000	3,582.00	47	48	65	75w. 13.00	.90
Brampton . .	5,000	3,500.00	....	500	....	7.00	.70
Tillsonburg .	2,976	2,601.00	....	223	....	60w. 11.00	.87
Hespeler. . .	3,089	1,500.00	....	120	....	100w. 12.50	.50
						75w. 15.00	
Seaforth. . .	1,900	1,815.81	....	116	....	60w. 12.00	.95
Weston . . .	2,300	2,052.00	....	171	....	100w. 12.00	.90
Milton. . . .	2,000	1,200.00	....	150	....	100w. 8.00	.60
Mitchell. . .	2,000	1,675.00	....	87	....	100w. 13.80	.84
Acton. . . .	1,750	1,000.00	....	147	....	100w. 12.00	.58
New Hamburg.	1,624	1,827.00	...	200	....	100w. 9.00	1.13

Residence Lighting

A service charge of 4c per month per 100 sq. ft. of floor area has been standardized plus a consumption charge depending on local conditions. There is practically no exception to the fixed rate of 4c. The meter rate varies from 2½c to 5c and averages about 3½ per kw.h. Some municipalities also give very liberal discounts. The rates as at December 31, 1913, are also given in Table VI.

Reductions from the above figures have been made in a number of cases to apply to the present year's operations. For example, St. Thomas' domestic lighting rate is now 4c and 2½c with 20 per cent off; Port Arthur's is 4c and 2½c with 10 per cent. off; Ottawa's is 4c and 2½c with 20 per cent off; London's is 4c and 3c with 25 per cent off; Preston 4c and 4c with 20 per cent off. In the majority of cases, however, the current year's rate has not yet been definitely determined.

Act as Consultants

Another feature of the Commission's work which has been greatly developed during the past year is in acting as consultants and advisers for any Ontario municipalities that may have any kind of electrical extension work in contemplation or under construction. As a result there is scarcely a town in Ontario where operations are municipally controlled that the Hydro-electric Commission have not had one of their engineers make a report on the plant. This is working towards greater efficiency of all these plants. It also means that the equipment being purchased is becoming much more rapidly standardized than would be possible were a less close relation existing between the municipalities. This service is rendered for all practical purposes free of charge and is eagerly sought and highly appreciated by municipalities not included in the zones actually served by the Ontario Commission's lines.

As examples we mention the assistance given to the city of Kingston in connection with their recent underground work; to the city of Peterborough in installing their magnetite arc lighting system for street illumination, and in Bracebridge where the power situation is being investigated with a view to supplying this town with more power. These are only isolated instances of a very large amount of work of an advisory nature being carried forward by the Commission's engineers.

Electric Railways

During the 1913 session of the Ontario legislature an act was passed which invests the Commission with power to inquire into and report on the cost of construction and operation of electric railways in any locality in which electric power may be supplied by the Commission. The act also authorizes any municipal corporation to enter into an agreement with the Commission for the construction and operation of electric railways, or for the construction by the Commission and their operation by the municipalities.

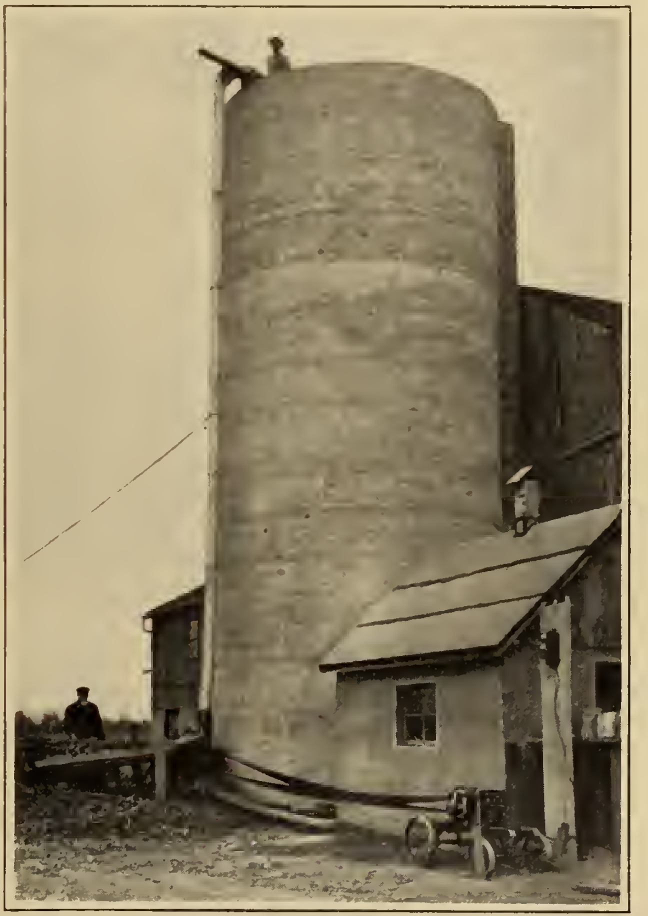


Fig. 34. Silo filling by hydro power.

As a result a very great amount of survey work has been carried out during the last twelve months. This work has been of a most accurate and complete character covering not only the cost of construction and operation of the line but taking into consideration also all the factors, as far as possible, which would be likely to influence the revenue provided by their operation. The surveys cover in the neighbor-

TABLE VI.

Municipality	Cost of Power to Municipality per h.p. per year		.... Power rates, 1913............					Lighting rates, 1913 Domestic		.... Commercial		
	1912	1913	Service charge per h.p. month	1st 50 hr. per month per kw-hr.	2nd 50 hr. per month per kw-hr.	All additional per kw-hr.	Prompt payment discounts	Per 100 sq. ft.	Per kw-hr.	1st 30 hr. per month per kw-hr.	All additional per kw-hr.	Prompt payment discounts
	$ c.	$ c.	$ c.	c.	c.	c.	%	c.	c.	c.	c.	%
Acton	.....	36 00	1 00	4.3	2.9	0.4	10	4	5	10	5	10
Baden	36 95	37 00	1 00	4.2	2.8	0.3	10	4	5	10	5	10
Barrie	.....	33 70	1 00	3.6	2.4	0.3	10	4	4.5	9	4.5	10
Beachville	33 89	31 00	1 00	3.9	2.6	0.3	10	4	5	10	5	10
Berlin	25 00	22 50	1 00	2.5	1.7	0.2	10	4	4	8	4	20
Brampton	29 00	25 00	1 00	3	2	0.25	10	4	3	6	3	10
Caledonia	29 10	29 10	1 00	3.7	2.5	0.3	10	4	4	8	4	10
Coldwater	.....	28 00	1 00	3.2	2.1	0.3	10	4	4	8	4	10
Collingwood	.....	33 97	1 00	3.6	2.4	0.3	10	4	4.5	9	4.5	10
Dundas	17 00	16 00	1 00	1.6	1.1	0.15	15	4	3	6c 1st 25 hr. 3c next 75 hr.	0.15	10
Elmira	.....	.....	1 00	4.7	3.1	0.4	10	4	5	10	5	10
Elmvale	.....	31 00	1 00	3.6	2.4	0.3	10	4	4.5	9	4.5	10
Galt	25 00	22 00	1 00	2.3	1.6	0.2	25	4	4	8	4	25
Georgetown	.....	36 00	1 00	4.3	2.9	0.4	10	4	5	10	5	10
Guelph	25 00	22 00	1 00	2.3	1.6	0.2	25	4	4	8	4	20
Hagersville	.....	33 21	1 00	3.9	2.6	0.3	10	4	4.5	9	4.5	10
Hamilton	17 00	16 00	1 00	2.1	1.4	0.2	25 & 10	4	3	6c 1st 25 hr. 3c next 75 hr.	0.2	20
Hespeler	26 00	23 00	1 00	3	2	0.25	10	4	4.5	10	10	10
Ingersoll	28 00	25 50	1 00	3.3	2.0	0.3	10	4	4.5	9	4.5	10
London	28 00	24 00										
Mimico	30 74	30 00	1 00	3.6	2.4	0.3	10	4	4	9	4.5	10
Milton	.....	28 00	1 00	3.1	2.1	0.3	10	4	4	8	4	10
Midland	21 00	20 30	1 00	1.7	1.1	0.15	10	4	4	8	4	20
Mitchell	38 00	37 00	1 00	4.5	3.1	0.4	10	Special rates 70c per. mo. minimum.				
New Hamburg	32 00	32 00	1 00	4.2	2.8	0.3	10	4	5	10	5	10
New Toronto	.....	.....	1 00	3	2	0.25	10	4	4	8	4	10
Norwich	30 00	32 00	1 00	3.5	2.3	0.3	10	4	4	12	4	10
Ottawa	15 00	15 00										
Penetang	28 80	26 50	1 00	1.7	1.1	0.15	10	4	4	8	4	10
Petersburg	..... Served by Baden		1 00	5.1	3.4	0.4	10	4	6	12	6	10
Port Arthur	20 30	19 50	1 00	2.25	1.75	1.0	..	4	3.5	8	3.5	10
Port Credit	36 79	31 00	1 00	3.7	2.4	0.3	10	4	4.5	9	4.5	10
Port Dalhousie	....	22 30	1 00	2.1	1.4	0.3	10	4	3	6	3	10
Port Robinson	....Served by W'll'nd		1 00	1.8	1.2	0.15	10	4	3	6	3	10
Port Stanley	59 75	55 50	1 00	5.5	3.7	0.5	10	4	5	10	5	10
Preston	25 00	21 50	1 00	2.3	1.6	0.2	10	4	4	8	4	10
Rockwood	.....	38 00	1 00	4.7	3.1	0.4	10	4	5.5	11	5.5	10
Seaforth	41 00	40 00	1 00	4.9	3.3	0.4	10	4	5	10	5	10
Sebringville	....Served by Str'tf'rd		1 00	5.4	3.6	0.4	10	4	5	10	5	10
St. Agatha	..... Served by Baden		1 00	5.1	3.4	0.4	10	4	6	12	6	10
Stayner	.....	.....	1 00	4.7	3.1	0.4	10	4	5	10	5	10
St. Mary's	38 00	29 50	1 00	3.6	2.4	0.3	10	4	5	10	5	10
St. Thomas	32 00	29 00	1 00	3.3	2.0	0.3	10	4	4	8	4	10
Stratford	32 00	30 00	1 00	3.6	2.4	0.3	10	4	4.5	9	4.5	10
Tillsonburg	32 00	32 00	1 00	3.8	2.5	0.3	10	4	5	10	5	10
Toronto	18 50	15 00	1 00	1.5	1.0	0.5	10	4	3	8	3	10
Waterdown	37 50	26 00	1 00	3.5	2.4	0.3	10	4	5	10	5	10
Waterloo	26 00	23 50	1 00	2.5	1.7	0.2	10	4	4	8	4	20
Welland	.....	14 50	1 00	1.8	1.2	0.15	25	4	3	6	3	25
West Hamilton	....Served by Dundas		1 00	2.8	1.8	0.2	10	4	4	8	4	10
Weston	30 00	30 00	1 00	3.3	2.2	0.3	10	4	4	8	4	10
Woodstock	26 00	23 00	1 00	2.5	1.7	0.2	10	4	4	8	4	25

hood of 600 miles of railway lines to date, for the most part covering territory west of Toronto and immediately north in the Markham and Uxbridge district.

A very marked enthusiasm has been shown by the municipalities interested and the climax of this enthusiasm was reached when a few days ago a deputation comprising some 2,000 representatives, sent by interested municipalities, assembled in Ottawa to place their claim before the Dominion government for the usual subsidy which amounts to $6,400 per mile. Premier Borden accorded the deputation a most careful hearing and there is little doubt but that the subsidy will be forthcoming in the comparatively near future. With many of the municipalities this would be the signal for authorizing the Commission to proceed with construction work.

In order to give the Commission all possible assistance as well as to forward their own interests the municipalities have formed themselves into a Provincial Hydro-radial Association. Officers have been appointed and a campaign of education has been started consisting of lectures and addresses in any town or village where sufficient interest can be aroused to get a fair-sized gathering collected. This scheme also has met with very gratifying success and if enthusiasm counts for anything the next five years should see south-western Ontario netted with a system of radial railways.

The value of radial transportation to the communities of Ontario cannot well be over estimated and it is questionable if any phase of the work of the Ontario Hydro-electric Commission will compare in actual value to the province at large with that of the development of hydro-radials. The power distribution scheme is in the main a work for the benefit of the cities and towns, and only in isolated cases have the rural populations reaped any direct advantage. The hydro-radial scheme is a countryman's proposition, however, and as such will receive the support of every rural inhabitant in the province.

At present writing it looks as though the first section of hydro radials to be constructed and operated will be the one running north from Toronto through Markham township. This is one of the most favored agricultural districts in Ontario and being off the main line of any of the steam railway roads it has received less attention in the way of transportation than it deserves. It is believed that a system in this section can be made to pay from the very start.

Book of Wiring Rules

Another important feature of the Commission's work has been the compilation of a book of rules and regulations governing wiring. Early last year a tentative set of rules was prepared and submitted to engineering bodies, manufacturers, contractors, electrical workers and jobbers as well as fire underwriters. These bodies were requested to consider the proposed regulations and submit any criticisms to the Commission. After considerable time had been given to a study of the proposed rules and regulations criticisms were received and acted upon. The regulations for the most part follow closely along the lines of the National Electric Code which has been the adopted standard in Canadian and United States practice and of the Fire Underwriters Association. In the Hydro regulations the arrangement of the code has been considerably altered and many rules for the protection of life, not found in the National Code, have been added.

In addition to these rules and regulations a complete bylaw was prepared in printed form for the use of the various municipalities where inspectors were to be appointed. This is saving the municipalities much confusion and loss of time and also provides for uniform installation and inspection. In this by-law the inspector's duties are well defined. A uniform scale of inspection fees has also been compiled and included. The law now requires that every municipality shall appoint a properly qualified inspector. The same inspector may attend to one or more municipalities depending on the amount of work entailed. Great care is taken in the selection of these men and the Ontario Hydro-electric Commission undertake to explain to the appointees the purpose of the work and the nature of the duties they are expected to perform.

Up to the present time a large number of appointments have been made and it is certain that a marked improvement in the quality of electrical work being done in all classes of buildings will be immediately noticeable.

Electric Testing

During the early months of 1913 a building designed to accommodate departments engaged in experimental work was completed in Toronto. This building is 110 x 70 ft. of three storeys and a basement, about one-third of which will be devoted to laboratory work and the remainder for storage of the large quantities of construction material, lamps, meters and other incidental supplies always carried in stock by the Commission. The laboratory contains a standard and meter department, an illuminating engineering department, a high tension and general testing department, and a lamp testing department.

The meter testing department has been organized and equipped with a view to proving the efficiency of all meter apparatus before it is installed by the different municipalities. The equipment of the new laboratory has been selected and installed with a view to making all the necessary tests. The equipment includes a first-class oscillograph put in in portable form so that it is now possible to make detailed investigations of matters affecting the current wave form at any point in the system. This department has from time to time done such work in this connection as has enabled the Commission's engineers to locate and take steps to remove a number of disturbing factors in the distribution system.

Considerable work has been done by the Commission in gathering data on all kinds of street lighting apparatus so as to be able to give reliable advice and information to the municipalities. During the past year information has been collected which enables the Commission to form accurate judgments both as to the artistic value of any particular kind of equipment and also the resultant illumination derived from it including such details as watts per linear and square foot, average illumination, maximum and minimum illumination and so on. Other points considered have been the distribution obtained by certain reflectors, the absorption of reflecting or diffusing media, mechanical strength, installation, and in general the suitability of any particular type of apparatus taking into consideration the price as well.

The high tension and general testing department is equipped with a 300 kv.a. 300,000 volt, 60-cycle transformer and a 50 kv.a. 37,500/75,000 volt, 25-cycle transformer. These transformers are used in determining the break-down voltage by flash-over or puncture of the various insulators used. Equipment has been installed also whereby tests may be carried out under artificial rain conditions. In this laboratory tests are carried out on the oil used in transformers and switches in the various sub-stations and by the municipalities. In general it may be said that electrical and mechanical tests of line apparatus may be made in practically any desired manner, special apparatus being manufactured in the laboratory workshops to meet any special conditions that may arise.

Lamp Testing Department

In the lamp testing department tests are conducted to determine the relative quality of the different makes of lamp and the quality of each from time to time during its life. On life tests all tungsten lamps are burned at the same efficiency and are measured at their rated voltages. After test, curves are plotted showing the performance of the different lamps. This data considered along with the cost of the lamp indicates which type is the most economical to use. Every known lamp, either carbon or tungsten, with a fair reputation has been subjected to exhaustive tests by the Commission.

Hydro on the Farm

The Ontario Commission have shown an entirely commendable attitude towards the application of electricity to farm use. The chairman of the board has been unceasing in his efforts to reach the rural population and has lost no opportunity to place himself in direct contact with the farmer so as to learn intimately all his needs at first hand and at the same time win his confidence in the sincerity of the commission's efforts and their ability to be of assistance. Mr. Beck has held himself available for lectures and demonstrations in any part of Ontario and it is gratifying to note that what has appeared more in the light of a theoretical possibility has been rendered a practical fact as the result of the businesslike tactics pursued by the Commission.

It would not be truthful to say that the use of electricity on the farms of south-western Ontario is general, but where conditions have been shown most favorable the results are very gratifying. At the present time some twelve townships are using electricity more or less on their farms. The fortunate farmers are those situated closest to the transmission lines connecting or serving the towns and villages along the way.

The cost of power to the farmer depends, of course, upon how many consumers there are per mile as it is necessary to make a service charge to each consumer to pay for the cost of construction of the line. Where there are three consumers per mile this works out to about $3.00 per service per month. Five consumers per mile works out at about $2.00 per month and so on. In rural distribution work the customers have been divided into three clases (1) the consumer who wants light only; (2) the consumer who wants light and small motors up to (say) 5 h.p., and (3) the consumer who wants light, small motors and a larger outfit (say 20 h.p.) for such work as threshing and silo filling.

To the class A customers the Commission gives a single-phase service and in fact all customers with motors of 2 h.p. or less are served by single-phase. For class B a three-phase service is given. In the case of class C it is the custom to get a number of farmers, seven or eight, to form a syndicate and buy and use a twenty h.p. motor in common, the same syndicate to purchase a threshing machine, silo filler or any other similar equipment requiring so much power and only used two or three days each season. In this latter case the syndicate also purchase their own transformers.

In certain localities power is sold on a meter rate and in others on a flat rate. For example, in the township of Toronto there is a fixed charge of $24.00 and a flat rate of $36.00 per h.p. per year. Up to October 31, 1913, there were 11 miles of distribution line built in this township, 72 customers connected and 132 customers signed up but not yet connected up. In the township of West Oxford there is a fixed charge of $36.00 per annum with a flat rate of $30.00. In Waterloo the fixed service charge is $24.00 with a meter rate of 5c per kw.h. or a flat rate of $30.00 per h.p. year at the choice of the customer. In North Norwich township there is a fixed service charge of $24.00 with a meter rate of 4c or an alternative flat rate of $36.00 per h.p. year. In Grantham township the fixed charge is $24.00 and the meter rate 4½c with an optional flat rate of $22.00.

The farmer provides all poles, wire and other equipment on his own premises, the municipality paying the cost of the wire as far as the first pole on his property. The municipality also owns the meter where one is used. The cost of wiring varies from $1.25 per outlet for open work to $2.50 per outlet for concealed work. The Ontario Commission have got out standard plans and designs for the wiring of barns and farm houses with suitable locations for motors, water heaters, etc., and are in a position to recommend to the farmer a suitable layout for his house and farm buildings which will give him a maximum amount of service with a minimum outlay. At the same time the necessary precautions are always observed in the wiring of barns and houses on the farm in order that all fire risk may be eliminated.

The usual installation for a 250-acre farm (it is a fact that the scheme as yet is more practicable on farms of 250 acres and up) as recommended by the Commission is that a farmer install a complete lighting system in the house, barns, cow stable, etc., with two lights in the farm yard and one outside the gate on the road. For power purposes he is advised to permanently install a five h.p. motor in some suitable position in the barn so that he can drive a milking machine, grinder, turnip pulper and in many cases a pump all off the same shaft. In some cases it may be necessary to install a small motor for pumping or for running a cream separator and churn in the milk house.

Another installation strongly recommended by the Commission is a water heater in the residence or in the milk house. This consists of a twenty-gallon can surrounded with packing so that the heat will not escape and fitted with an electric heater. The heater is a 600 watt unit and though it only raises the temperature of the water slightly it can be kept on during the off-peak load of both night and day so that the farmer will always have on hand a goodly supply of hot water.

The Commission have performed a number of painstaking experiments of threshing grain and filling silos with motors of different sizes and are ready to supply the farmer with either a 20 h.p. motor or with smaller equipment even as low as a five h.p. outfit. The smaller equipment is not likely to find favor in Canada but a syndicate of four to eight farmers can supply enough power even for threshing.

Lighting the Roads

There has always been a demand for a certain amount of light along the rural roads and though it is not necessary to have as much illumination as in more thickly populated districts, lights are very convenient at such places as railway crossings, bridges, culverts, etc. In districts where cost is of primary importance it has been the custom to install one 100 watt tungsten outside the gate of each farmer who is being served with power. The light is placed on a cross arm and controlled by a switch near the front door of the farm house. In districts where more complete lighting is required installations of 100 watt lamps with radial reflectors have been installed about every 1,000 feet.

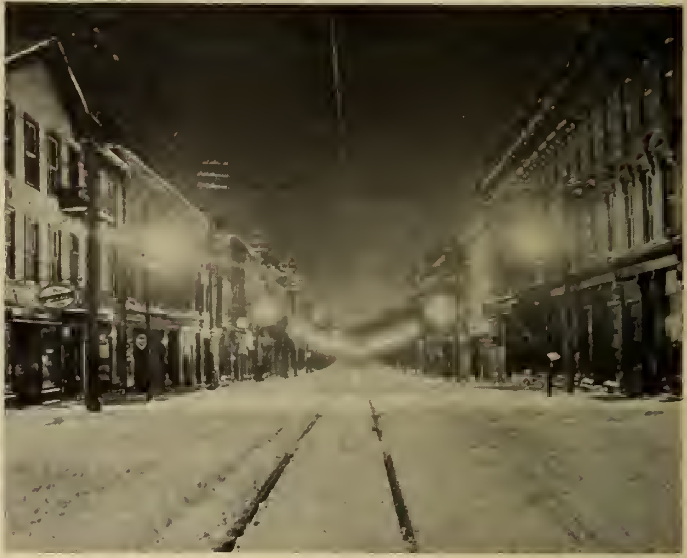


Fig. 34a—Street Lighting by Magnetites in Peterboro.

Procedure where power is required by any township is made as simple and easily understood as possible. A petition is required from the township desiring the power, and then the Commission's engineers investigate the conditions and lay out a distribution system from the nearest town in the vicinity or by installing pole type transforming stations along the 13,000 volt line, if there are any such in the township. Power is transmitted to and through the township at 2200 volts by a three-wire, three-phase system. The conductor is No. 6 hard drawn copper wire on a four-pin cross arm on poles 25 or 30 feet high. As the distribution grows in extent in any township the system is changed over to the 4,000 volt four-wire distribution system with a No. 6 copper clad steel neutral run along the top of the poles. In most cases each farmer has his own transformer, 2200/220-100 volts, except where two houses are very close to one another.

Fall Fairs

A feature of the educational campaign carried on by the Commission has been the demonstrations of hydro-electric applications to farm work at the different fall fairs. Demonstrators were on hand to operate and explain the various uses of the appliances and all farm machinery was shown in actual operation. These demonstrations have always been the center of interest and have been the means of giving the farmers some new and accurate ideas on power possibilities in their work.

Typical Municipal Distribution Systems

(Specially contributed)

Hamilton

The Hamilton Hydro-electric System receives its power from the Ontario Power Commission's sub-station at Dundas. The power is transmitted at 13,200 volts by two circuits on wooden poles. When the system is completed, this will be replaced by four circuits on steel towers. At present, it is received at two sub-stations, one a temporary shack in the west end of the city, and the other the permanent east end sub-station. Their capacities are 1,200 and 2,150 kilowatts respectively.

In the completed system, there will be three sub-stations; the first, a small switching and transformer station at the corner of Dundurn and Head streets, near the western city limits; the second, the central sub-station, on Hughson street; and the third, the east end sub-station at the corner of Trolley and Burlington Streets. See Fig. 35 for wiring diagram of the primary system.

At the west end sub-station the power will be received through four circuits at 13,200 volts from Dundas. From there, two 13,200 volt underground lines will feed the central sub-station, 6,000 feet away, while two overhead lines at the same voltage will supply the east end sub-station and the city pumps at the Beach, and another will run to the Hospital for the Insane. The hospital buys its power direct from the Ontario Commission, but it is switched at the city's sub-station. The transformers at this sub-station will be three 250 kw., 13,200/2,200 volts, supplying three-phase delta feeders on wooden poles for power purposes, commercial lighting and street lighting. The switches will be Westinghouse type, lever operated oil switches.

At the central sub-station, both the incoming and outgoing lines will be run underground. The switches at this sub-station will be Canadian General Electric Company's type oil switches, and the transformers are to be seven 750 kw. single-phase, 13,200/2,200 volt, for small power purposes, commercial lighting and street lighting, and one 500 kw. three-phase, 13,200/550 volt for power purposes within a radius of half a mile from the sub-station. These and all the other transformers are supplied by the Canadian Westinghouse Company.

The east end sub-station and the pumping house at the beach, will be arranged so that they can either be operated on separate lines or together on either of the two lines from the west end sub-station. The pumping house is equipped with two 500 kw. 2,200 volt synchronous motors, each connected to a centrifugal pump.

The east end sub-station is to have Westinghouse type switches and six 500 kw. 13,200/2,200 volt transformers for power purposes, commercial lighting, and street lighting in the eastern part of the city.

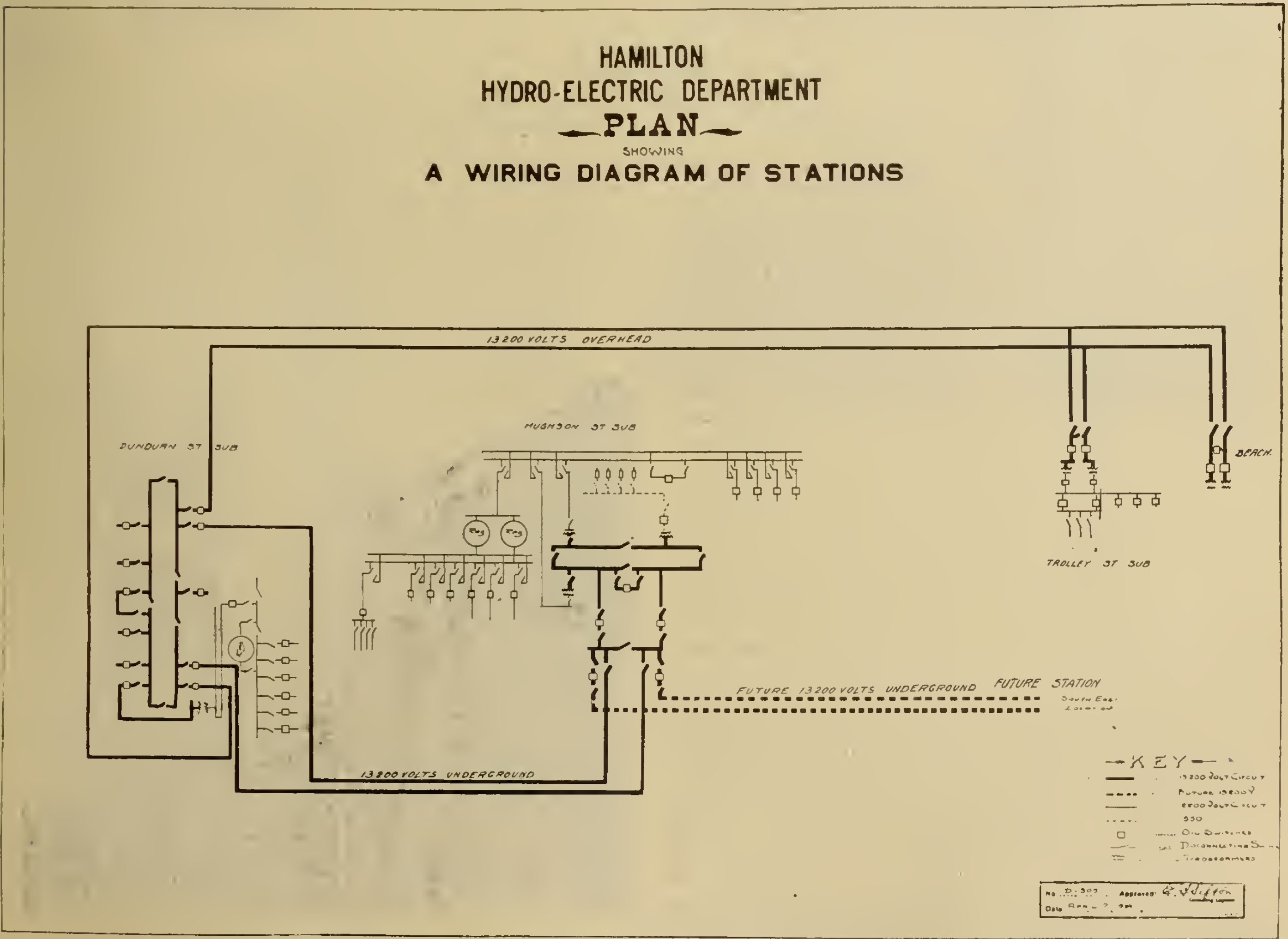


Fig. 35.—Wiring diagram of Hamilton's three substations.

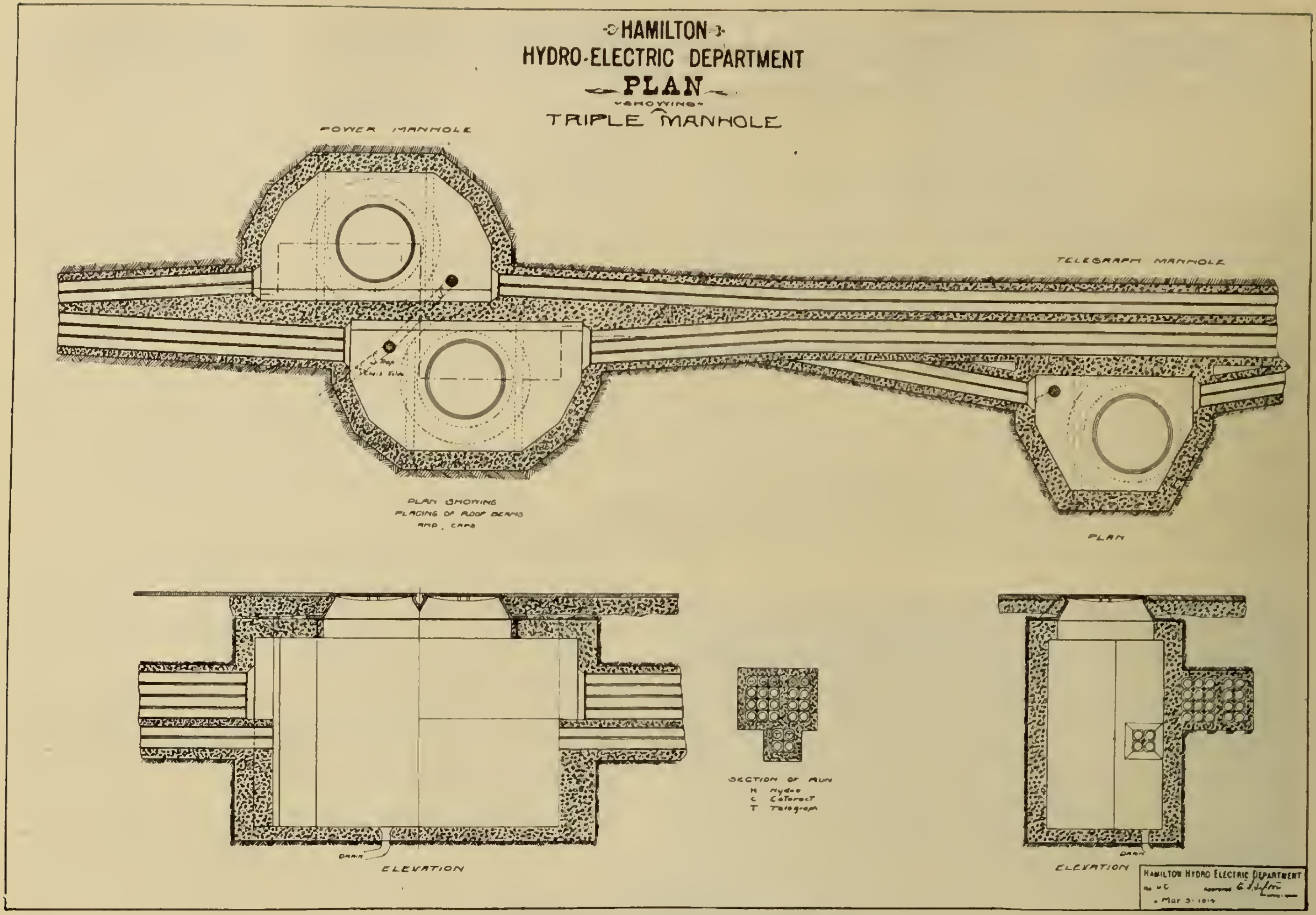


Fig. 36—Showing plan of triple manhole—Hamilton City.

Distribution

In the centre of the city, the distribution will be underground, about seven miles of conduits being laid in the main streets. The construction of these conduits is much the same as for the Toronto system, described in former numbers of the Electrical News. The Dominion Power, Light and Transmission Company and the telegraph companies will use the same trenches, but different manholes, see Fig. 36. Mr. G. M. Gest, contractor, of New York and Montreal, is constructing the conduits, and the cables are made and installed by the Standard Underground Cable Company of this city. Through these conduits, the current will be supplied from the central sub-station at 2,200 volt to transformers on overhead structures, in the courts in the centre of each block. Here it will be transformed to 110/220 volt for commercial lighting and to 220 volt, three-phase from the same bank of transformers for small power purposes. The secondary wires will be run in conduits or on brackets along the rear walls of the buildings to individual services, Fig. 37. This is one of the unique features of the Hamilton system. The 550 volt power will be distributed in the same way from 550 volt potheads on the transformer structures.

The overhead distribution will be divided into three districts. The 2,200 volt three-phase feeder lines in the east and west districts will be fed from their sub-stations direct, while in the central districts they will be supplied from the underground conduits. These lines run on wooden poles both ways across the city from 1,500 to 2,000 feet apart. In each district they will be tied in at the intersections, so a break will not put any part of the district out of commission. It will be arranged that if any sub-station breaks down, the others will supply its district through pole type disconnecting switches.

From transformers of 15 to 30 kw. capacity on these poles and on concrete poles at the edge of the underground district, Fig. 37, current is fed at 110/220 volt to secondary circuits on concrete poles, Fig. 39. Notice the wire running along the tops of these poles. This wire is of No. 6 galvanized mild steel, and is grounded at each pole and to the water pipe at each house lighting service. This is used in a fourfold capacity, first, as a lightning arrester; second, for me-

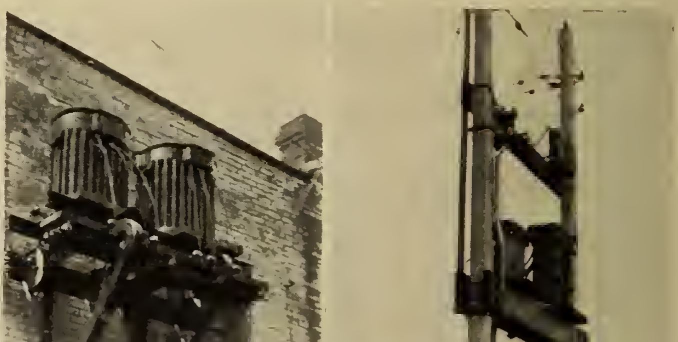


Fig. 37—Transformers installed on rear of building and on cement poles—Hamilton City.

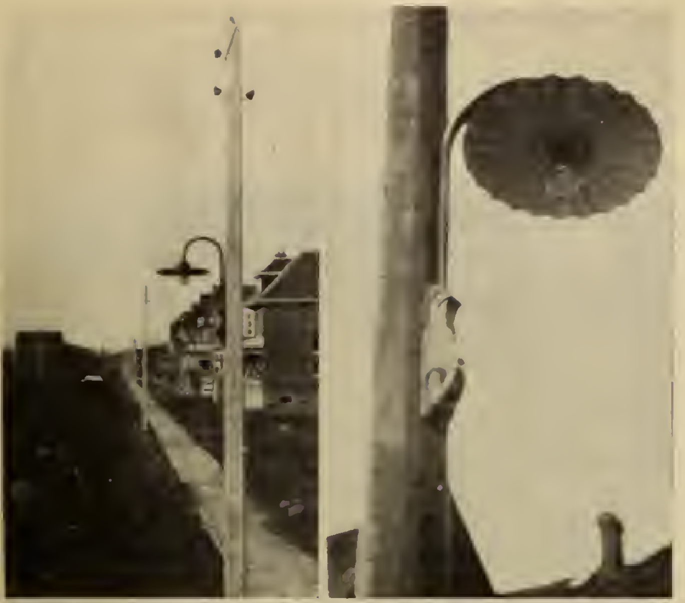


Fig. 38—Types of street lighting—Hamilton.

chanical strength; third, as neutral for the three-wire 110/220 volt house lighting secondary circuit; and fourth, as neutral for the three-wire 110/220 volt street lighting secondary circuit This is another unique feature of the system.

Street Lighting

In the overhead districts the distribution for street lighting will be the same as for house lighting described above, the wires being strung on the same poles. A 250 watt tungsten lamp on the poles at street corners, seventeen feet above the ground will mark the intersections of the streets, while 100 watt tungstens on all other poles 12½ feet above the ground and 100 feet apart will light the streets almost uniformly throughout their length, Fig. 38. Streets with car tracks will be lighted from both sides, other streets from one side only.

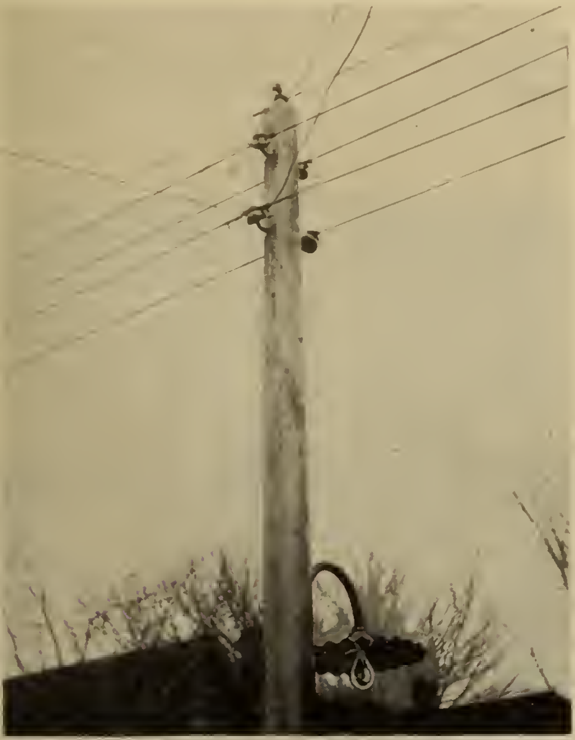


Fig. 39—Showing 5-wire distribution system.

In the underground districts the street lighting feeders, like those for commercial lighting will be run through tile conduits set in concrete, 2,200—110/220 transformers in manholes will supply the secondary circuits, which will be run in fibre conduits. The lamp to be used in this district is a 1,000 candle-power, 500 watt, 110 volt nitrogen filled tungsten, mounted on a cast iron standard 14 ft. 6 in. high and set from 125 to 200 feet apart. The city parks are also to be lighted with ornamental standards, but these will be fed from a buried cable instead of from conduits.

History and Management

In the summer of 1911, the ratepayers of Hamilton voted $500,000 for the construction of the City's Hydro-electric System, Mr. E. I. Sifton, of London, Ontario, was engaged as engineer and business manager and under his capable direction, the system has been laid out. Mr. H. Barber was appointed as assistant to Mr. Sifton, in 1910, but resigned in 1912. In January of the present year an additional $335,000 was voted and a change made in the government of the department. At first the Board of Control had charge of the department, but now it is governed by a Commission elected by the citizens.

The Hamilton system is the only one that started to take on load as soon as it started construction, and it has shown a profit from the first. The growth of the system is shown in the chart, Fig. 28. The department is already lighting some streets and will light the rest this summer.

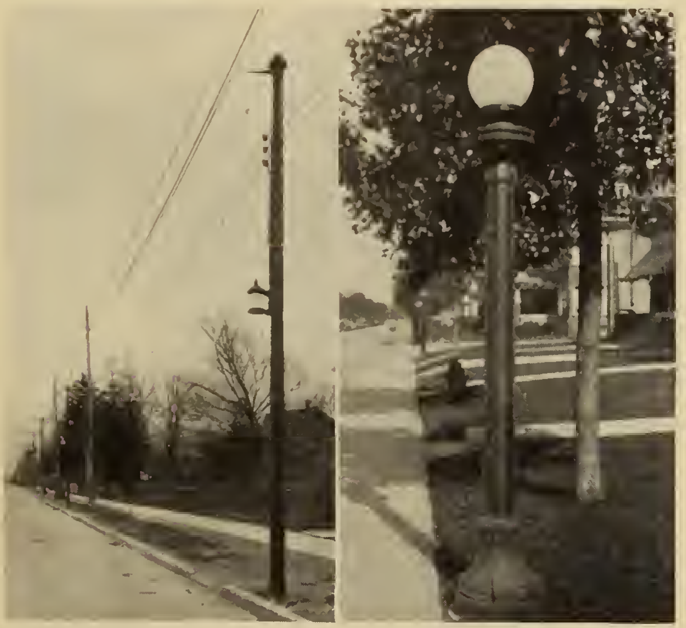


Fig. 40—Toronto street lighting. Ornamental type; also combined lamp and trolley pole.

One of the interesting features of the accounting department is the system of unit costs. The average cost of erecting wooden and concrete poles, of stringing the wires, of connecting meters and services, etc., has been worked out. For this purpose all time and material is charged to some specific job and none to the often abused general work order. All overhead charges (capital cost, operation, maintenance, etc.) are divided proportionally into the following revenue-producing classes, house lighting, street lighting, power and water works. By this means equity of rates is assured.

Staff

The Hamilton Hydro-electric Commission consists of Messrs. W. Ellis (chairman), J. Allan (Mayor, ex-officio member) and T. J. Stewart, M.P. One commissioner will be elected each year. Mr. Stewart's term of office is to expire at the end of this year.

E. I. Sifton, the chief engineer, is ably assisted by the following heads of departments,—H. O. Merriman, assistant engineer; J. A. Woodman, superintendent of construction; W. H. Childs, contract manager; Wm. Macmillen, accountant; S. Robins, purchasing agent.

Toronto

Very marked progress has been made by the Toronto Hydro-electric System. Though the first year's operations far exceeded the expectations of the local Commission the last year has shown no abatement in development both technically and commercially. The commercial progress is shown in the annual report just issued. This report gives the number of meters in use as 24,999 as compared with 13,858 a year ago, an increase of 80 per cent. during 1913. The number of street lanterns in use is 38,944 an increase of 15 per cent. The peak load in December, 1913, was 22,520 h.p. an increase of 31 per cent. over the peak load of the previous year which was also in December. The total income increased from $726,763 in 1912 to $1,159,339 in 1913, a gain of nearly 60 per cent.

The Toronto hydro-engineers have introduced a number of interesting features into their work. One of these is in connection with the underground construction work. A quite original idea has been introduced in connection with the construction of manholes and service boxes whereby these are now made up of concrete in preference to the regulation brick type. Special templates of metal and seasoned wood are used for constructing the two-way, three-way and four-way manholes (see figures). These templates or forms are placed in the excavation and filled in around with a standard mixture of concrete making a wall of cement approximately eight inches thick. The results have proved very satisfactory both as regards cost and in expediting the work and this method is now being successfully used on all their construction for man-holes and service boxes.

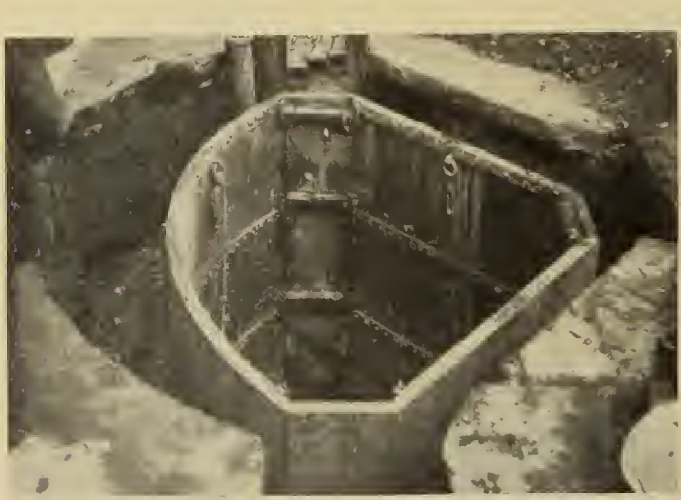


Fig. 41—Template for building manholes—Toronto.

One of our illustrations gives a fair idea of the obstructions met with from time to time in underground installation work. This is a view taken in connection with the subway at Macpherson Avenue and Poplar Plains Road.

As mentioned elsewhere an extension to accommodate certain city equipment has been built on the terminal station at Strachan Avenue. This equipment is designed to take care of the requirements of the city in that particular section, and removes the necessity of a sub-station in that district.

Another of our views shows the transformers at the high level pumping station. In this station there are four 750 kw. three-phase transformers, six 200 kw. single-phase transformers, two 500 kw. rotary converters. In a temporary structure at Withrow Park the city has recently added a 500 kw. rotary converter and three 200 kw. single-phase transformers to be used in connection with the supply of power to the civic car line on Danforth Avenue.

Fig, 42—Completed manhole with template removed—Toronto.

A number of small transforming stations have been erected in various parts of the city to take care of the increased power demands of large consumers in the respective localities. These small stations receive current at 13,000 volts and transform to 550.

In the matter of lighting Toronto has been one of the most progressive cities. The question of improved and efficient illumination on steam railway crossings has been under consideration for some time and several designs have been tried out. The type finally approved for general use, by the city authorities, consists of two enamelled reflectors supported side by side on a metal bracket arm standing out about three feet from the pole, Fig. 44.

These reflectors are of the elliptical type set at an angle to the crossing and mounted at an average height of 18 feet above the ground. The longer crossings have a double reflector fixture installed at each corner of the crossing just outside the gates. Each reflector contains one 250 watt tungsten which means a total of eight 250 watt lamps in all. A number of railway crossings are now lighted

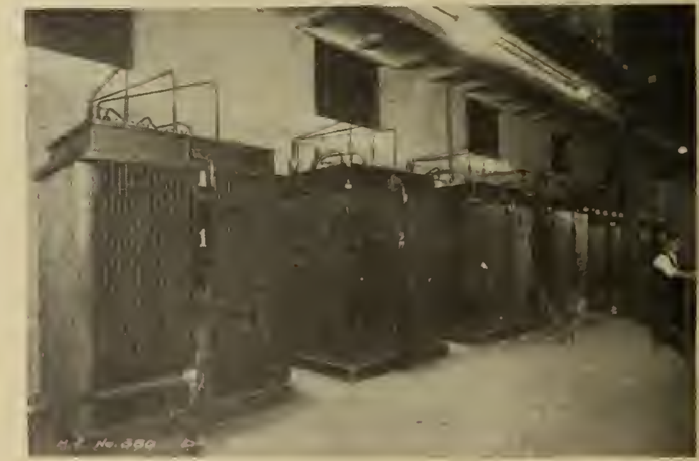


Fig. 43—Transformers, high level station, Toronto.

up in this manner, including Royce Ave., Greenwood Ave., etc.

For the purpose of giving a better light on street railway intersections a special cluster fixture is suspended over the centre of the street intersection. The special cluster fixture is suspended by span wires attached either to poles or to buildings located diagonally across the street. Either five or three 100 watt tungsten lamps are used in each instance, according to the conditions and traffic requirements. These fixtures are placed about thirty feet above the ground level.

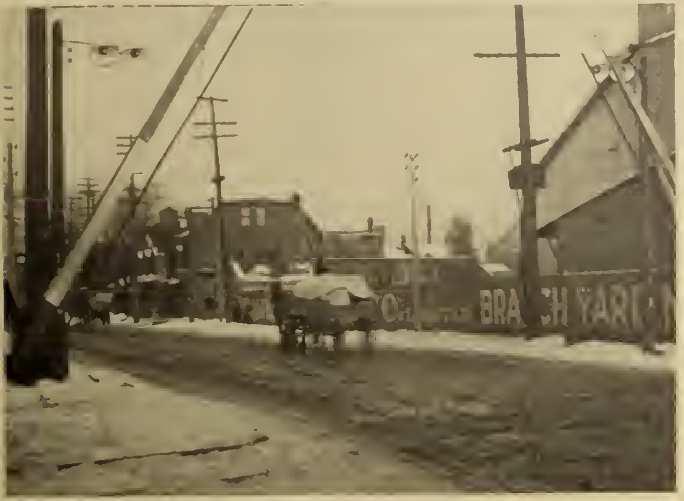


Fig. 44—Lighting steam railway crossings—Toronto.

A 1,000 watt, 2,000 candle power nitrogen lamp is under test at the intersection of King and Yonge Streets and has been in service since the early part of this year.

In connection with the fire alarm system a special lamp is being installed for indicating the position of the boxes. A special fixture and lamp which is covered with a red cylinder has been adapted by the city to indicate these locations. These fixtures are fitted to the top of the present lanterns in a vertical position. It is estimated that a total of 350 of these will be required to cover the city and work on their installation is at present in progress. See Fig. 52.

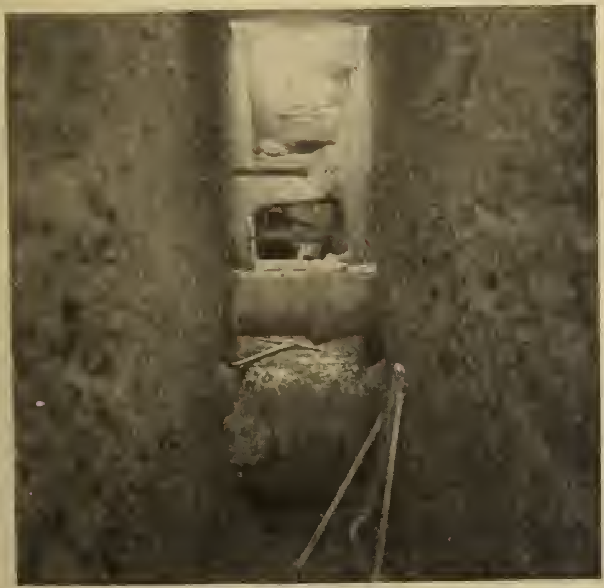
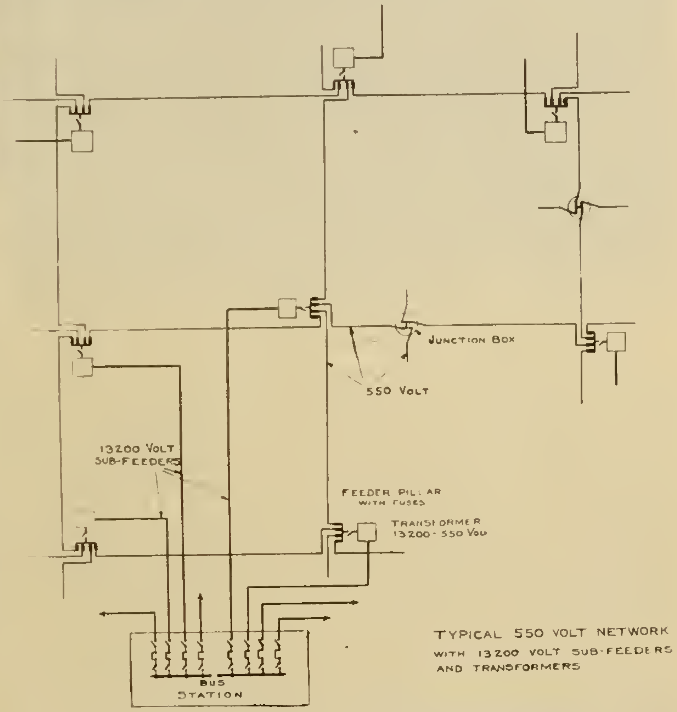


Fig. 45—Obstacles to underground work—Toronto.

Figs. 48, 49 and 50 are self explanatory and indicate the remarkable growth of the Toronto enterprise during the comparatively short space of time it has been operating. There are now 720 miles of streets covering approximately 35½ square miles being served.

Mimico

We have now about three hundred satisfied consumers who are using the Hydro for residence lighting and many more are contemplating taking out contracts. The rate of advance during the last few months leads us to believe that the growth during 1914 will double if not treble the growth of the system in 1913. We also have the district of Humber Bay under our supervision although outside our village limits. Our distribution in this district supplies light to about eighty residences the owners being perfectly satisfied with the service. Our latest undertaking is to install street lights from the Humber Bay West on Queen Street in the Township of Etobicoke for the distance of about one mile. Queen Street being the main highway through the market garden district west of Toronto, the importance of this line will be considerable.


Junction Box
550 Volt
13200 Volt Sub-Feeders
Feeder Pillar with Fuses
Transformer 13200 - 550 Volt
Bus
Station
Typical 550 volt network with 13200 volt sub-feeders and transformers
Fig. 46—Typical 550 volt power network--Toronto.

The street lighting system within the village limits is now extended to all sections and is quite efficient and this speaks well for the advance that has been made as the village is very scattered and covers a large area. Our power consumers, i.e., the Victoria Industrial School and Carl Grobba, florist, are well satisfied with their service and the revenue from these accounts is an important item to our commission.

Woodstock

Hydro-electric Power was turned on November 30, 1910, and during December was used to a limited extent for lighting and to operate a few small motors. In January, 1911, several large motors were installed in the mills and factories of the city and a load of 600 h.p. was reached; this has slowly but steadily increased up to the amount given below.

The large industries of Woodstock being woodworking with a large amount of refuse, it has not been possible to build up as high a load as had they been in other lines of manufacture. However, the convenience and general satisfaction derived from electric motors has been such that nearly every factory has one or more small motors in some part of the equipment, and it is a satisfactory point to note that following the first installation there is soon found to be just one or two other places where a motor would work in; so even the woodworking factories will eventually get in line.

The distribution system, as outlined in the November, 1910, number of the Electrical News has been adhered to with good results, outside of half a dozen or more small motors in the business part of the city, all the power is on 25-cycle, but the greater part of the business centre, as well as a considerable section of the central residential district, is still on 60-cycle. This is becoming more restricted every year for as the meters and transformers are moved in to supply the growing demand in the centre of the city, sections are changed to 25-cycle without discarding any apparatus. This policy the management propose to follow till the 60-cycle apparatus is worn out or obsolete, when the whole plant will be operated at 25 cycles and the present synchronous motor run for power-factor correction only.

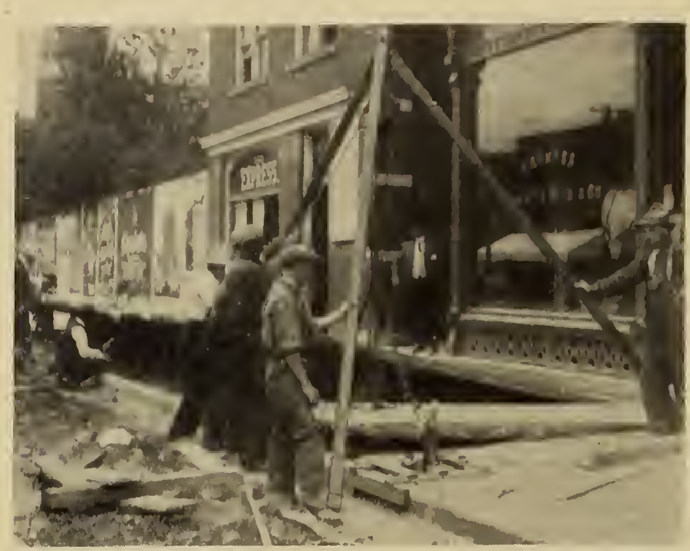


Fig. 47—Conduit under concrete walks—Woodstock.

One of the important changes brought about by hydro power is the much improved street lighting. The 90 arc lamps in use three years ago having given place to about 700 tungstens, over 400 of these being 6.6 amp. series lamps of 60 to 200 c.p. operated from two 15 kw. and one 20 kw. Canadian General Electric Company c.c. transformers. The balance are 60 and 100 watt multiple lamps in the centre of the city.

The main business street is lighted by 43 five-light standards manufactured by the Canada Foundry Company. These were installed in the summer of 1912 at a cost of $110 per pillar complete including one 15 kw. transformer and two time switches. Fibre conduit and lead covered cable was used entirely, about 4,000 ft. in all being required. The fibre conduit was laid in concrete under the sidewalks close to the curb, Fig. 47. This was done to avoid breaking the street pavement and also to clear the gas pipes which are laid along both sides of the street just under the gutter.

The sidewalks being flag stones, 10 to 12 ft. long by 3 to 5 ft. wide presented the greatest obstacle. This was overcome by raising the outer end about three feet with a chain block and derrick, see Fig. 47; and blocking in position with wood horses, made up for the occasion. Fifty to one hundred feet would be taken up, by which time the conduit would be laid for some distance, and the derrick gang would start replacing the flags. This had to be done very carefully in order to have the walk smooth on top. The men soon became expert, however, and left the walks in better shape than they were before; a very few stones broken in handling were replaced with cement.

The wiring is in two circuits, one half of the lights going off at midnight, the rest running all night. Two Campbell time switches attend to this part of the work and require very little attention.

The Waterworks Department has been operated by electric power since May, 1911, and the same has shown greatly increased efficiency. The pumping equipment being located in an adjoining room to the power plant, is under the charge of the same operator and is used to control the peak load and keep up a good load factor. It is interesting to note that in December the account for power was only 34 h.p. more than for the month of July. This was made possible by the careful operation of the waterworks motors and also in a few cases of extremely dark afternoons, starting one steam engine for an hour or more, and taking care of the extreme peak.

Below is given the connected load in December, 1910, and March, 1914:—

Commercial	Dec. 1910	March 1914
Incandescent lights	560 kw.	970 kw.
Street arc lights	90 kw	——
Commercial arc lights	85 kw.	10 kw.
Street incandescent lights ...	——	700 kw.
H.P. in motors	250 kw.	1100 kw.

Owing to the low rates made possible by the use of hydro power, residential lighting especially has become very popu-

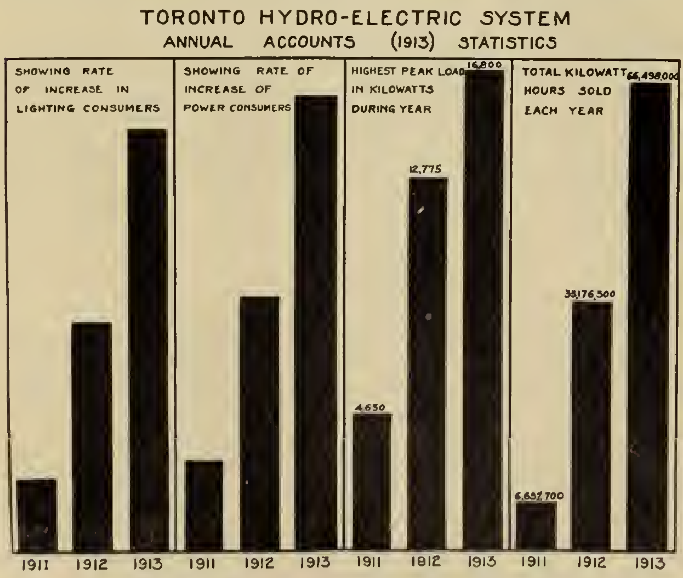


Fig. 48—Development of Toronto local system.

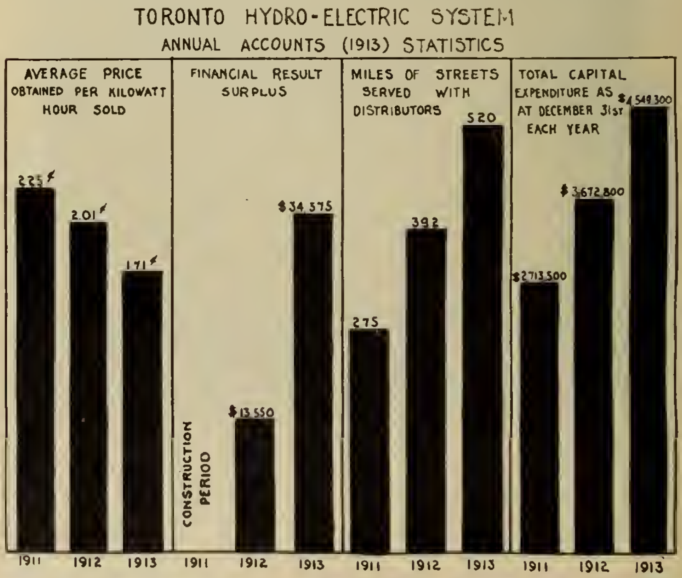


Fig. 49—Development of Toronto local system.

lar and is increasing rapidly, considerably over one hundred new customers being added since January 1st of the present year.

The Water and Light System is under the direction of the following Commissioners:—R. E. Butler, chairman, Col. John White, B. McNichol, J. G. McBeath, and Mayor Hobson; A. B. Lee is secretary-treasurer; J. G. Archibald, superintendent and electrical engineer; H. G. Hall, assistant.

Stratford

At the elections in January, 1910, the citizens passed a by-law creating a Light and Heat Commission consisting of 3 members, the Mayor, ex-officio, and elected J. J. Mason and Angus McDonald. The citizens have re-elected these two latter commissioners each time and they still hold office. At the election which created the commission the citizens turned down by an over-whelming majority a by-law to purchase the Stratford Gas Company's plant at $58,800, but the commissioners made arrangements with the Gas Company, for the operation of the plant for a period covering 10 years at a rental of $4,380 annually and on the completion of the 10 payments the plant was to become the property of the city. Later the citizens passed a by-law authorizing the issuing of bonds completing the purchase from the Gas Company for the sum of $43,800 in quarterly payments totalling $4,380 per year without interest.

In April, 1910, the city passed a by-law for $85,000 for general equipment and street lighting. This amount has been spent on construction, the work being under the supervision of Mr. C. J. Leacock and Superintendent R. H. Myers and possibly to these two men, more than to anyone else, we are indebted for the splendid equipment we have at present and at such a small cost. The street lighting system for several reasons was only a temporary arrangement and we have under consideration the submitting of a by-law for $22,000 to complete a street lighting system, which will be second to none for any city of our size in the province. In fact the by-law will be submitted to the City Council before this is in print and no doubt will be adopted by the citizens in the course of about 3 weeks. If this is done the equipment will be completed before the 1st of August, when we expect to have a Stratford Old Boys' Re-Union.

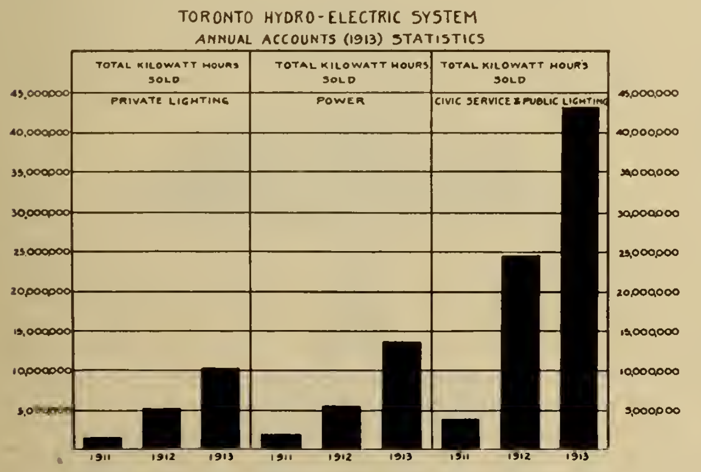


Fig. 50—Development of Toronto local system.

Mr. J. J. Mason has been chairman of the local commission with the exception of last year, when Mr. Angus McDonald was chairman. The other member of the first commission was Ex-Mayor Dingman, and these members gave unstintingly of their time and talents to the working out to a successful issue of Stratford's venture of a municipal ownership of an electric light plant.

This civic department has had unqualified success. In the 4 years since the plant was taken over the price of electricity has been reduced 33 1-3 per cent. and in December last the commission made a further cut of 20 per cent. in residential lighting and about 10 per cent. in commercial lighting. When the plant was taken over from the Gas Company, there were 318 customers and at the end of 1913 we had 1,545 customers. The revenue in 1909, the last year of the old Gas Company, was $25,386. Last year, for 1913 the revenue was $55,914, while the actual surplus on the year's operation was over $10,000 net, after providing for interest and sinking fund on debentures and also the payment of $4,380 on purchase price to the Gas Company.

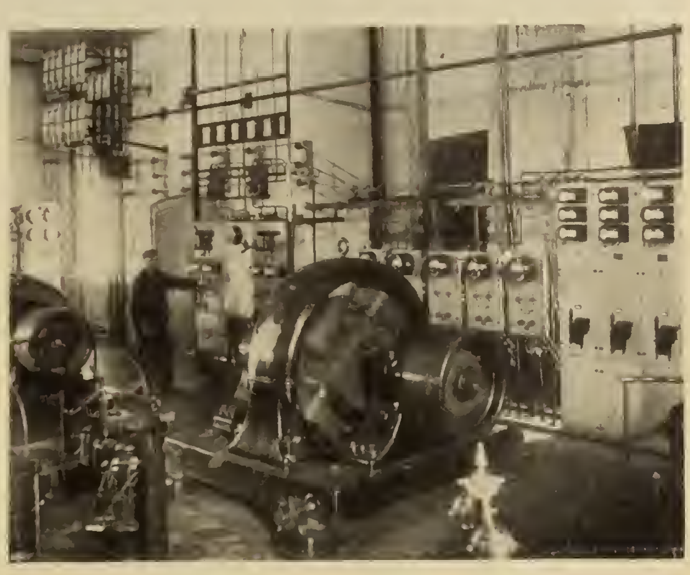


Fig. 51—Interior municipal station—Stratford.

A branch line to Sebringville was built last year and in January last our load nearly reached the 1,000 h.p. There is no public question in this city stands so high in the estimation of its citizens as our Hydro-electric Power proposition.

Fig. 51 is a view of the interior of the Stratford Municipal sub-station. From right to left the first panel shown is a 160 ampere power panel; the next two are lighting panels 50 amperes each, and the next five are series tungsten street lighting panels; the lightning arresters for the above panels are shown overhead. The three panels following are direct current, and belong to the two direct current dynamos, one in the foreground and the other behind the synchronous motor. This equipment was taken over by the city from the Stratford Gas Co. The panel in the far corner belongs to the synchronous motor shown driving the second direct current dynamo. The four tanks shown against the rear wall are aluminium lightning arresters for the in-coming 13,200 volt line. The bank of switches shown near the ceiling over the synchronous motor panel belongs to the six 150 kv.a. transformers situated in a part of the room not shown on photograph.

Fig. 52—Toronto's Fire Alarm Signals.

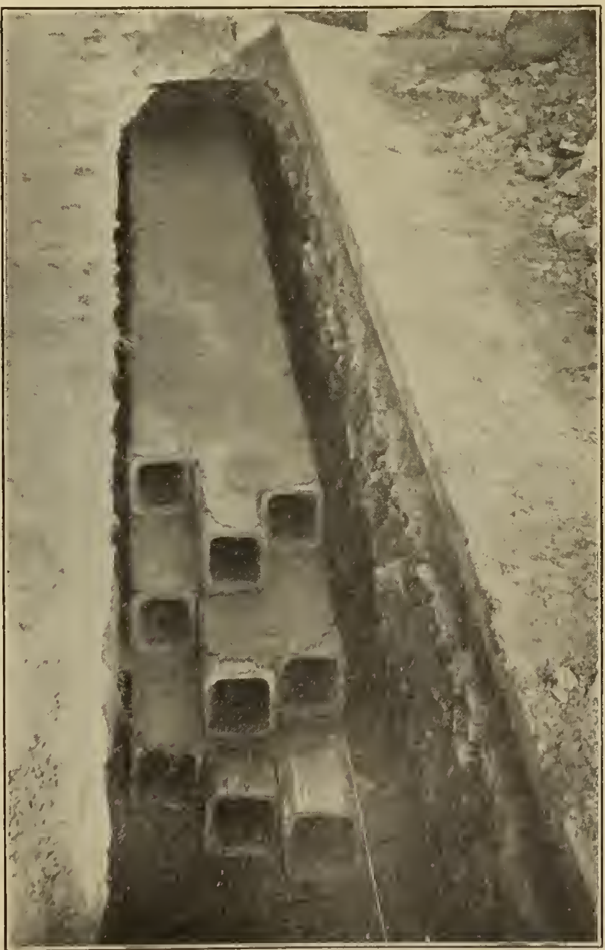
The Dealer and Contractor

Underground Work in Kingston

The "Limestone City," Kingston, Ont., has followed the example of many of the other cities of Canada by having the central business area freed from all the objectionable and unsightly overhead electric wires, so that the principal parts of the city are now clear of everything but the ornamental standards, and the Civic Utilities Committee feel that Kingston has shown that it is quite as progressive as some of the more widely advertised municipalities.

The section of duct run from 4 to 18 in number. All runs were completely surrounded with a 3-in. concrete envelope. All ducts used were of the single square bore type. This was chosen on account of their laying together more firmly and taking less cement to bind together. The manholes have concrete base and tops. The sides were made of brick on account of the irregular shapes that had to be used, brick proving cheaper and more satisfactory.

Two or three brick service boxes (size 36 in. x 38 in.) were located between manholes. The bottoms of the services were left practically in line with bottom duct so that services would drain to manholes.


Typical underground work in Kingston.

For each manhole a connection to sewer was made and trapped in the usual manner. Two-inch iron pipes were run from these service boxes to buildings. This pipe was laid directly in ground after being painted with asphaltum.

At present no transformers are placed in manholes. The transformer poles are located at intervals on side streets adjacent to duct runs.

The conditions of construction encountered were somewhat serious; almost every manhole was sunk in the worst type of blue limestone, and to add to the difficulties of excavation caused by the presence of this limestone, was the serious inconvenience occasioned by the modern sewers and gas pipes and the old stone sewers constructed decades ago, which had to be removed or filled in. In the vicinity of these operations quite a few old coins were found, some dating back hundreds of years.

Specifications and plans for this contract were made in detail by the Hydro-electric Power Commission of Ontario. The Commission's inspector was present throughout the whole of the construction.

The contract was carried out by Dietrich, Limited, of Montreal, and the work is entirely to the satisfaction of the local committee as well as to the inspectors of the Hydro-electric Power Commission of Ontario. The following quotation from a Kingston paper is of interest.

"The engineer of the hydro-electric assured the deputation that the manner in which the conduits were being laid in the city was the best in the country. Local officials are satisfied that the work is being done better here than in any other place they visited."

High Potential Fuses

The Economy Fuse & Manufacturing Company of Canada, Limited, Montreal, have recently acquired the sole right of manufacturing in Canada, S & C Extra High Potential Fuses—Canadian Patent No. 140056, dated April 14th, 1912.

These fuses are made of a toughened glass tube which is filled with a non-inflammable liquid of extremely high dielectric strength, having none of the objectionable characteristics of oil. The liquid extinguishes the arc and interrupts the current flow, this action being still further accelerated by the contraction of a spiral spring simultaneously with the melting of the fuse element, thus introducing a very large gap. Since the dielectric strength of the liquid is about 250,000 volts per inch, this gap between the top ferrule and the top end of the submerged spring gives a factor of safety equivalent to several hundred thousand volts.

Numerous tests have been made, subjecting the fuse to severe conditions of short-circuit, and the results obtained were so remarkable that prominent engineers, both from this country and abroad, are said to have expressed themselves most favorably regarding the results of the tests and the future possibilities of the fuse.

During one investigation a total of 43 fuses were tested on short-circuit and all opened the short-circuit successfully without causing the overload relays to trip the oil switches on the generators and transformers used in these tests.

Until within two years the most efficient high-voltage circuit interrupter for power work has been the oil-break switch controlled usually by some form of overload relay. On a system protected by apparatus of this type all the desired requisites are not obtained, owing to the frequently unreliable operation of overload relays, which in turn depend upon proper action of series transformers, and the heavy, slow-moving oil switch, which of necessity must be built of heavy parts to withstand severe short-circuits. These conditions render it almost impossible for a switch to operate with sufficient rapidity to prevent the entire system from becoming affected under short circuit conditions.

When the volume of current flowing is comparatively small, as characteristic of high voltage systems, circuit interruption by means of reliable fuses is claimed by many engineers to be preferable to the use of circuit breakers or oil switches. The type of fuse described above not only clears the circuit more effectively and rapidly but also has the decided advantage of a considerable saving in investment.

Electrose Arcover Line and Strain Insulators

Louis Steinberger, an inventor well known in the insulator art, has succeeded (after a vast amount of labor and costly experimenting, having had to overcome seemingly insurmountable difficulties) in producing on a commercial scale what are believed to be absolutely reliable suspension line and strain insulators for every voltage. These "Arcover" insulators are said to meet every requirement in a highly satisfactory degree. Their efficiency will doubtless at once receive due recognition from leading engineers and electrical manufacturing and constructing companies in all parts of the world.

These Arcover insulators are the only insulators with imbedded interlinked strain or suspension members that are made up of a single, integral and uniformly solid mass of insulating material without joints. Even though the insulating material should become totally destroyed, the line cannot possibly fall to the ground.

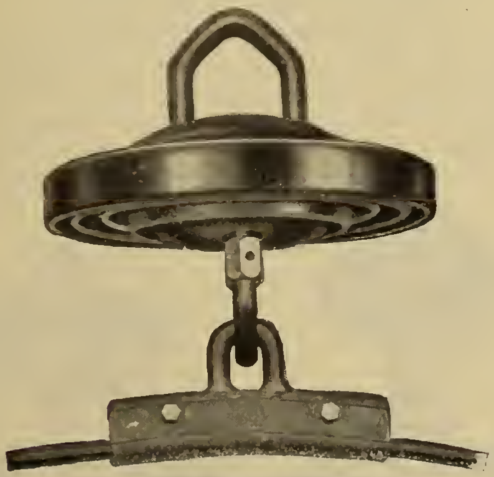


Fig. 1

The electrical and mechanical values of these insulators have been worked out to a degree of perfection never before attained in this class of devices and are in excess of ordinary requirements. Therefore they are especially well adapted for applications where unusually severe conditions prevail. These insulators possess a number of original and desirable features. Two or more units may be connected or disconnected in a fraction of a minute, no special tool being required; a plain wrench, a nail or even a piece of wire is all that is needed. No extra connecting member is required and there are no loose parts to be lost. The spacing of the units in their relation to each other has been worked out on scientific lines, to the best possible advantage.

The novel form of line clamp shown in connection with the Arcover insulators is also an invention of Mr. Steinberger, and possesses many admirable features; it has a smooth bore for gripping the wire or cable, thereby preventing crystallization and the possible breaking of the conductor at or near the clamp. It is designed so as to grip conductors of various diameters. It is light in weight, but sufficiently strong to break the conductor before slippage occurs. The metal parts employed in all these insulators are made of galvanized drop-forged steel.

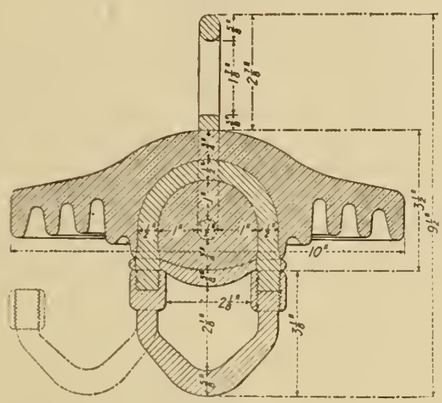


Fig. 2

In the table below are given the electrical and mechanical values of the 10-inch Arcover disk suspension and strain insulators, also of the 7.5-inch Arcover disk strain insulators:

	7.5-Inch Disk Strain Insulator	10-Inch Disk Strain and Suspension Insulator
Puncture value, in oil	120,000 volts	150,000 volts
Tested to dry arc value ...	85,000 volts	100,000 volts
Rain arc value	55,000 volts	55,000 volts
Line voltage	25,000 volts	25,000 volts
Mechanical value	20,000 lbs.	20,000 lbs.
Tested to	10,000 lbs.	10,000 lbs.

Arcover disk strain insulators are made in the following diameters: 5.5, 7.5, 10.5, 12.5 and 14.5 inches. Arcover disk strain and suspension insulators are made in the following diameters: 8, 10, 12, 14 and 16 inches. These insulators are made by the Electrose Manufacturing Company, 60 Washington Street, Brooklyn, N.Y., of which Mr. Steinberger is president.

New Companies

Stanworth Power Company, Limited, has been incorporated with head office Toronto; capital $250,000.

The Upton Electric Company, Limited, has been incorporated with head office Upton, Que.; capital $99,000.

The Bagot Electric Company has been incorporated with head office Saint Pie, Que.; capital $99,000.

The Canada Light & Power Company of Saint Jean Chrysostome, Que., has been incorporated with capital $140,000.

The Tillsonburg Electric Car Company, Limited, have been granted authority to increase their capital from $40,000 to $100,000.

The Skootamatta Power & Development Company, Limited, has been incorporated with head office Hamilton.

The Canadian Turbine Company, Limited, has been incorporated with capital $50,000, and head office Toronto.

Personal

Mr. Robert Greer has been appointed general electrician and foreman of the Weston electric light and waterworks system.

Mr. Allan Pierson has been appointed general superintendent of the Weston Electric Light & Waterworks Commission.

Mr. H. M. Vanbuskirk has been appointed manager of the Prince Edward Island Telephone Company, succeeding Mr. W. S. Grant.

Mr. Arthur J. Cantin has been appointed electricity inspector for the Inland Revenue Department of Canada for the district of Edmonton.

Mr. F. R. Glover who formerly had charge of the Vancouver and suburban system has been relieved of this post in order to allow him greater freedom in his duties as general executive assistant, an appointment he received in 1912.

Mr. W. G. Murrin has been promoted to the position of general superintendent of the B. C. Electric Railway Company, an appointment which somewhat alters his position with the company, his previous field being as mechanical superintendent to which there is now added the supervision of the company's Vancouver city and suburban street railway system.

Mr. R. H. Sperling, general manager of the British Columbia Electric Railway Company, Vancouver, has been offered a seat on the London board of his company, an offer which carries with it the appointment of Mr. Sperling to an important executive position as assistant to the chairman of the board, Mr. R. M. Horne Payne. It is understood that Mr. Sperling will accept the new post and that on his return from England, where he has gone to confer with the directors, the name of the company's new general manager will be announced.

Mr. Sperling joined the service of the B. C. Electric Railway Company in 1896 and in the following year was appointed the electrical expert in charge. He later became general superintendent of the company and on the appointment in 1905 of the then general manager, Mr. J. Buntzen, to a seat on the London board, Mr. Sperling was chosen as his successor.

The change in the personnel of the staff of this company on account of the promotion of the general manager to service in London, does not mean that there will be other changes in the staff in this province or that the policies of the company will be altered in any way. The organization and work of the company has been gradually built up as the result of years of practical experience, and it is stated that this organization and plan of work will be continued practically unchanged. This new post has been recently created because of the rapid development of the company's work, and the great increase of its investments in British Columbia. The offer of the position has been made to Mr. Sperling because the London board recognizes that he is fully equipped for this important field of work owing to his long residence in British Columbia, his intimate knowledge of the company's work as gained by practical experience during the period of the company's great development, and his detailed knowledge of the company's general policies.

Windsor Street Station, Montreal

In our April 1 issue we described the electrical features of the new C. P. R. Windsor station, Montreal. We failed, however, to note one of the most important items, namely, that the lamps supplied were the well known Northern Lights manufactured by the Northern Electric & Manufacturing Company.

Washing Machine Display

The accompanying photograph shows a display of "1900" electric washing machines recently made in the windows of the Toronto hydro-electric shop. The display consisted of an electric motor-driven washer and wringer also a motor driven and electrically heated ironing machine. An actual demonstration of washing was given where clothes were washed, put through the wringer and then ironed. This display attracted an unusual amount of attention on the part of the passers-by.

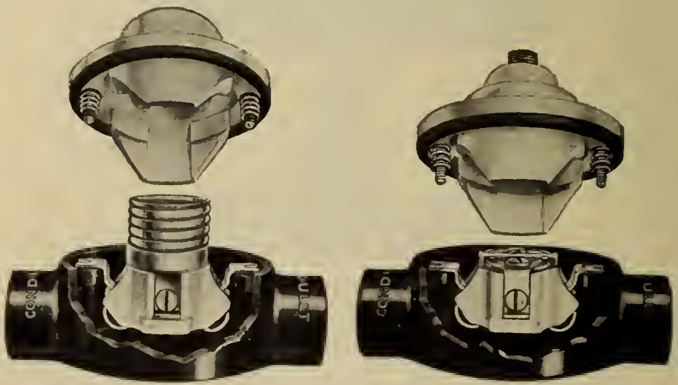
Washing Machine display in Hydro window.

Moonstone Glassware

Following critical tests on various types of glassware we understand the Toronto Hydro-electric Power Commission have decided to adopt Moonstone glass for all their street lighting work.

New Condulet Bodies With Elliptical Openings

The illustrations herewith represent type RJ elliptical condulet bodies so designed that elliptical conduletto fittings and elliptical covers fasten to them by means of two screws which are always accessible. These two screws secure both cap and base of the elliptical fitting to the condulet body. A gasket is furnished with each fitting which makes the installation waterproof. Ample space is provided in the condulet body for the unobstructed passage of extra wires.


Two views of Type RJ, showing Elliptical Conduletto Rossette.

This equipment is being placed on the market by the Crouse-Hinds Company of Canada.

Hamilton Section C. E. A.

The Hamilton section of the Canadian Electrical Association at their monthly meeting held on March 26 heard a lecture on "The Mississippi Power Plant, Keokuk, Iowa." The article was written by Mr. Walter Goodenough and presented by Mr. L. W. Pratt, sales manager of the Hamilton Electric Light Company; the lecture was illustrated by a large number of lantern slides. At the same meeting Mr. S. Holland of the Canadian Westinghouse Company gave a practical demonstration of the use of the pulmotor in resuscitating persons subjected to electric shock. The musical part of the programme was prominent as usual.

Electric Washer De Luxe

The White Dove Company of Cobourg, Ont., are putting on the market an electric washing machine which is creating a considerable interest among central station men and dealers. The manufacturers claim that this machine has been subjected to the most severe tests and has stood up in a way which gives them entire confidence in its operation. It derives its name from its color, being finished in white enamel and bronze and presenting a very neat appearance. The accompanying illustration shows one of the washing machines of this company.

Electric Vehicle Convention in Philadelphia

The Electric Vehicle Association of America will hold its fifth annual convention this year in Philadelphia during October, the exact date to be announced later.

242. **Electrical material.**—A large firm in Columbia, South America, inquires for electrical material.

Trade Notes

Chain Blocks—Bulletin B3 issued by the Herbert Morris Crane & Hoist Company, Limited, Toronto, describing the Morris travelling spur-gear chain block. Particular attention is drawn to the snug construction of these travelling lifting gears, the chain block being built right into the trolley so that no head room is wasted. Some interesting information is given and price lists are appended.

Electric Vehicles—The joint committee of the Electric Vehicle Association of America and the National Electric Light Association have distributed a little booklet entitled "Electrical Vehicle In Parcel Post Service for Economy and Reliability."

Fused Switches—A pamphlet issued by the Detroit Fuse & Manufacturing Company describing the Detroit iron-clad fused switches.

Welding and Cutting Plants—Booklet issued by the Waterhouse Welding Company, Boston, Mass.

The Hubbard Reference Book—Messrs. Hubbard & Company, of Pittsburgh, Pa., have just issued their 1914 reference book with which is combined a catalogue of Peirce brackets and other construction specialties of Hubbard manufacture. This book is especially remarkable for the number of very excellent illustrations it contains showing many examples of the latest and most improved practice in overhead line construction work. Another interesting feature is a list giving construction details of 131 different high tension lines, compiled from articles that have appeared in electrical journals the world over. This list is accompanied by seventy-five diagrams showing the tower construction used. The latter half of the book is given over to a catalogue of Peirce specialties covering their varied lines of wall brackets, pole brackets, secondary racks, knob fixtures, tungsten brackets and pole line brackets which they manufacture now for practically every voltage. We predict that this book will find a place in the reference library of electrical men from technical engineers to linemen.

Pole Reinforcement—Booklet issued by Messrs. Hubbard & Company, Pittsburgh, describing their methods of pole reinforcing by the Orr patent process. The Hubbard Company are successors to the Pittsburgh Reinforcing Company in the manufacture of this equipment.

Electric Control—Bulletin No. 242, issued by the Canadian General Electric Company, describing the Sprague electric control systems for newspaper and rotary magazine presses; well illustrated.

Panels and Cabinets—Bulletin 34, issued by the Canadian Krantz Electric & Manufacturing Company, Limited. describing their panels and cabinets. This bulletin is well illustrated and contains also price lists of the various types of equipment manufactured by this company.

Condulet Fittings—The Appleton Electric Company of Chicago have just issued a very complete catalogue illustrating and describing their useful line of unilets and conduit fittings.

Railway Signals—Bulletin 115C, issued by the General Railway Signal Company, Rochester, N.Y., describing their model 2A signal; bulletin 106A describing their improved lightning arrester model 1B; bulletin 130 describing their rail clips and conductor bars.

Port Arthur Has Good Year

The results of the operation of the electric and telephone departments of the city of Port Arthur, for the past year, have just been announced. In the electrical department the total revenue was $174,733. After deducting operating expenses the gross revenue was $107,864; with further deductions of fixed charges $37,556, and bad debts $1,200, the net gain for the year was $69,106. The number of consumers is 3,400. The domestic lighting rates are now 4c per 100 sq. ft. plus 2½c per kw.h., less 10 per cent. discount. The commercial lighting rates are 6c for the first 30 hours use of installed capacity and 2½c per kw.h. for all in excess, less 10 per cent. The total revenue of the telephone department was $46,097 and the net gain after all charges are deducted, $1,728. The number of subscribers is now 2,700. The domestic rate is $15.00 and the commercial rate $30.00 per annum. Mr. J. J. Hackney is Commissioner of Utilities.

Current News and Notes

Arnprior, Ont.

The town council has closed an agreement with the Galetta Power & Milling Company under which the latter agree to supply light at 75c per month per 60 candle-power lamp during 1914.

Barrie, Ont.

Permission has been granted the Toronto, Barrie & Orillia Railway Company to operate their cars on Sunday. The bonding privilege has been increased from $30,000 to $40,000 a mile and the time to complete the line has been extended to five years from the passing of the act.

Brigden, Ont.

A contract has been awarded to Harry Smith of Petrolea for the wiring and installation work in connection with Brigden's new street lighting system.

Calgary, Alta.

Recommendations have been made by the Calgary commissioners having in view the removal of all poles in the central section of the city. The Alberta government telephone department and the Calgary Power Company are asked to co-operate with the city in having all wires placed underground within a certain stated area.

The commissioners have recommended that the city railway system be given a reduction in their power rates from 1¾c to 1.6c per kw.h.

Chandler, Que.

The Parsons Pulp & Lumber Company will install at Chandler, Que., two 1,000 kw. turbo-generator sets and about twenty-five induction motors scattered through the different departments of their pulp mill. These motors will range in size from 15 to 150 kw. This equipment is being supplied by the Canadian General Electric Company.

Edmonton, Alta.

An order has been placed with the Siemens Company of Canada for 700 water meters of the vane type with frost protection.

A by-law has been submitted asking authority to expend $120,000 on electric light extensions.

Guelph, Ont.

An extension of time for the completion of certain branches of the Guelph Radial Railway system to five years from the passing of the act has been granted by the Railway Committee of the Ontario legislature.

Halifax, N.S.

The Siemens Company of Canada have received an order from the Acadia Coal Company, Nova Scotia, for two 380 h.p., three-phase, 2200 volt, 60-cycle, 146 r.p.m. induction motors of the slip-ring type provided with short circuiting and brush lifting device, together with liquid starters and cast iron mining pillars. These motors are to be used for driving air compressors.

Hamilton, Ont.

The Dominion Power & Transmission Company have let further contracts in connection with their auxiliary steam generating plants as follows:—Condensing outfit together with boiler feed pumps to the Canadian Westinghouse Company; two stacks to the Canadian Kellogg Company; boilers to the Edge Moor Iron Works, Edge Moor, Deleware.

The tenth annual report of the Canadian Westinghouse Company for the year ending December 31, 1913, is just to hand. The financial statement shows the total assets of the company to be $8,446,605. The profits for the past year were $1,002,618 which was distributed as follows:—Dividends at 9 per cent. $445,026; bank interest $28,700; reserve for insurance fund purposes $50,000; written off property and plant $250,000; carried forward to profit and loss account $228,891. The total profit and loss account now stands at $1,531,491. The capital stock of the company is $5,000,000. There are no bonds.

The plant of the Canadian Porcelain Company, Limited, at Hamilton, is now operating full time. Practically the entire output is high voltage porcelain of which the Hydro-electric Power Commission of Ontario are large users.

Montreal, Que.

The Siemens Company of Canada, Limited, have obtained a contract for two and four core submarine cable to be installed between Prince Edward Island and Nova Scotia, a total length of 28 miles. The two-core cable is for telephonic purposes and the four-core for telephonic and telegraphic purposes.

The Siemens Company of Canada have received an order for 5 sets of 12,000 volt switching apparatus including oil switches, panels, etc.; also for 4 sets of lighting arresters, each set to consist of 3 horn gaps, triple pole oil immersed damping resistance, special triple pole choke coil together with disconnecting switches. This order was received from the Canada Cement Company.

Preliminary plans for an extensive hydro-electric scheme are being drawn up by an English firm of engineers for the Lachine Rapids Power Company. This company was incorporated in December of last year. It is proposed to develop power on the north and south sides of Heron Island, in the centre of the Lachine Rapids. For several months engineers have been obtaining the requisite data for the scheme, which, it is said, will cost several million dollars. A director of the company states that sufficient capital has been guaranteed to ensure the plan being carried out, and that a ready market for the power can be obtained in Montreal.

J. D. Lachapelle & Company, Montreal, have obtained a contract for two complete electric plants, including generators, switchboards and search lights, for the Three Rivers and Longueuil ferry boats now being built at Levis, P.Q. Each of the plants will include a 12½ kw. generator of the C. & C. Electric & Manufacturing Company's make with Robb vertical engine. The generator is to be 120 volts compound wound. With the ferry for Three Rivers there will also be furnished a 14-inch Carlisle & Finch searchlight. A system of automatic control for the signal lights will be installed on both ferry boats. In both instances the installations are to be entirely done in galvanized iron conduit.

It was stated, in error, in our last issue that La Cour motor convertors had been sold by the Ferranti Electric Company to the Canada Cement Company and Messrs. Armstrong, Whitworth and Company. The sales were made to these companies by Messrs. Roper, Clarke and Company, Montreal, the Eastern agents for Messrs. Bruce Peebles.

Mr. James Bennett of Montreal, has been retained by the Shawinigan Water and Power Company to examine the company's distribution lines, transformers, entrances and other details affecting the condition of the company's distribution system to Three Rivers, as regards its compliance with the regulations of the fire underwriters.

Ottawa, Ont.

The Ottawa Municipal Electric Commission is contem-

SIEMENS BROS. DYNAMO WORKS | SIEMENS BROS. & CO.

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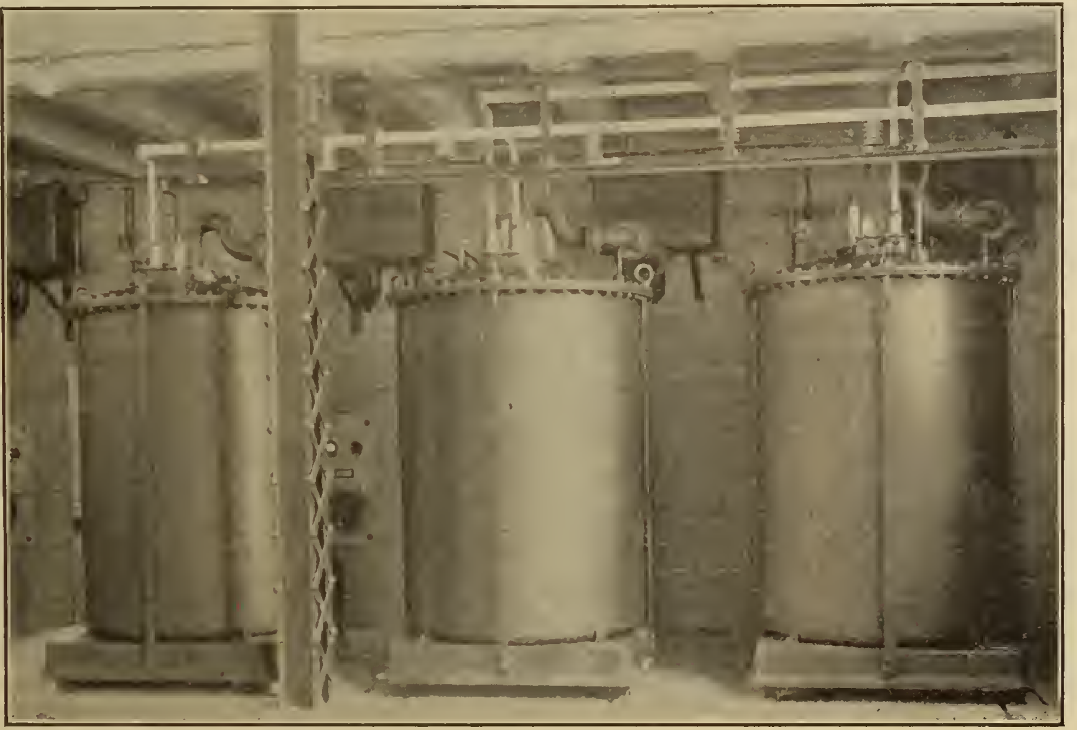


3 of 7 Siemens 750 K. V. A. 22,000 Volt Single Phase Oil Insulated Water Cooled Transformers Supplied and Installed at the Hydro Electric Power Commission's Substation, Port Arthur, Ontario.

Four of the above were a repeat order after the first bank had been in successful operation for eighteen months.

We also supplied the whole of the switching apparatus, lightning arresters and two 750 h.p. motor generator sets.

Attention is specially drawn to the expansion vessel connected by a pipe to the top of the transformer case. The transformer, including this connecting pipe and part of the expansion vessel, is completely filled with oil, expansion and contraction of the oil taking place in the expansion vessel.

By means of the "U" shape of the connecting pipe, the hot oil, by the time it rises to the expansion vessel is sufficiently cool so that no hot oil comes in contact with the air, and no moisture can enter the transformer itself. This arrangement also keeps the oil in perfect condition and prolongs the life of the transformer.

The Siemens Companies undertake the complete equipment of electric plants of every description, including Transformer Stations up to 110,000 volts.

Siemens Company of Canada Limited

HEAD OFFICE:
Transportation Building - MONTREAL

BRANCH OFFICES:

STANDARD BANK BUILDING
TORONTO

[illegible]

McARTHUR BUILDING
WINNIPEG

plating making some substantial additions and extensions to their plant as the present equipment is taxed to the utmost to take care of the business offering.

Sometime during the coming summer the Ottawa Electric Railway Company will open a new steam auxiliary power plant on Middle Street, near the Chaudiere Falls. This plant will be equipped with a 4,000 h.p. steam turbine, manufactured by the Westinghouse Company, also three Babcock and Wilcox water tube, marine type boilers to which will be attached chain feed stokers. The equipment is now being installed.

Sir Henry Egan, director of the Ottawa and Hull Power Company, and Lady Egan, are spending a vacation in Hot Springs, Va.

Mr. Thomas Ahearn and Mr. James D. Fraser, president and secretary-treasurer, respectively, of the Ottawa Electric Railway, returned last week from a month's visit to the Bahama Islands, Havana and Florida.

Peterborough, Ont.

The private bills committee of the local legislature has recommended that the city of Peterborough be given power to take over the distribution plant of the Peterborough Light & Power Company without being required to include the generating plant owned by the Auburn Power Company which is situated within the city limits and is practically a part of the system.

Quebec, Que.

In connection with the Sherbrooke-Derby Road being constructed by the Department of Roads of the province of Quebec we understand that public tenders are not called but that private tenders are called by correspondence.

Rossland, B.C.

A new 10,000 h.p. generating unit together with transformers and auxiliary equipment has arrived at the power site of the West Kootenay Power & Light Company at Bonnington Falls.

Regina, Sask.

The Flett Springs Rural Telephone Company have awarded a contract to Mr. V. O'Brien, Regina, to construct their telephone line.

Renfrew, Ont.

The town council has requested the Hydro-electric Power Commission of Ontario to submit an estimate on the cost of installing a complete system of street lighting.

St. John, N.B.

Tenders are called by the St. John Electric Railway Company for the erection of a new car barn 58 ft. x 115 ft., to be of brick and steel construction.

Saskatoon, Sask.

The keeping of a municipal electric store has proved rather disastrous in Saskatoon during the past year as is shown by a deficit of $1,527. A private company has offered to purchase the equipment at face value and carry on the business in the same location.

Stratford, Ont.

It is reported that nitrogen filled tungsten lamps will be installed for improving the street lighting system. A by-law will be submitted to the ratepayers in the near future.

St. Catharines, Ont.

The city has taken over the local line of the Ontario Power Company and St. Catharines citizens are being served since April 1 by their local commission.

St. John, N.B.

The amendments asked to the St. John River Hydro-electric Company's bill were defeated in the committee of the local legislature.

St. Thomas, Ont.

The St. Thomas Electric Manufacturing Company, manufacturers of electrical appliances, instantaneous electrical water heaters, etc., have opened a factory at 18 Catherine St.

Negotiations are proceeding between the city of St. Thomas and the officials of the London & Lake Erie Railway & Transportation Company looking to the operation of the municipal system by the company for a term of years.

Toronto, Ont.

All the different hydro-radial unions which have represented certain sections of western Ontario have been merged into one union to be known as the Provincial Hydro-electric Railway Radial Union of Ontario. Mr. J. W. Lyon, Guelph, is president, and Ald. Hannigan, Guelph, secretary.

A small fire occurred in the car barns of the Toronto & York Radial Railway Company on their Lake Shore Road line. Two cars were destroyed and $5,000 damage done to the building.

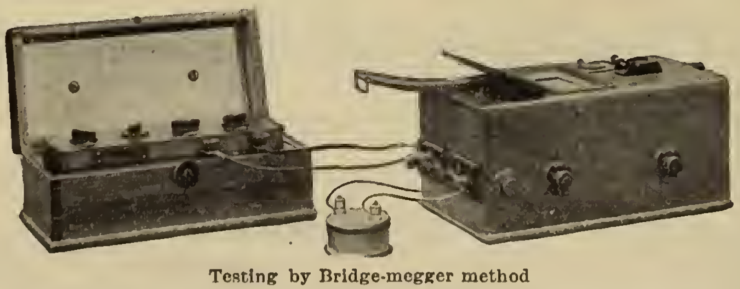
In the Railway Committee of the local legislature a motion has been passed ordering the Toronto Street Railway Company to continue the operation of its cars on Queen Street East to Munro Park. The terms of payment and service are left to the Ontario Railway & Municipal Board. This is a half mile line which was originally outside the city limits and which the company has maintained it is not under any obligation to operate. During the last two years it has been operated as a stub line and an extra fare charged.

It is understood that the Bell Telephone Company will construct a new exchange in North Toronto to be completed in 1915.

The question of public ownership and operation of telephones was debated at some length in the local legislature. The decision reached was that at the present time the suggestion is not feasible.

Evershed's Meggers and Bridge-Meggers

The only reliable standard for Insulation Measurements



Testing by Bridge-megger method

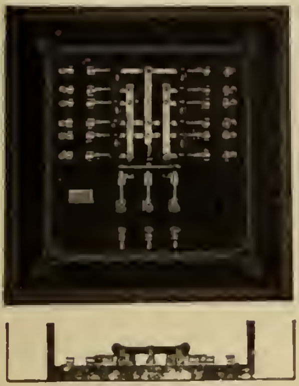
Used by Hydro-Electric Engineers, Contractors, Cable-Makers and Manufacturers throughout Canada.

Representatives at WINNIPEG VANCOUVER

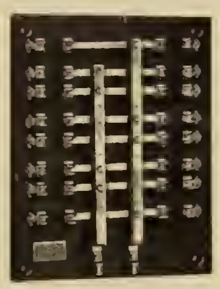
R. H. NICHOLS, Dineen Bldg., TORONTO

Representatives at MONTREAL OTTAWA

TRUMBULL
Panels and Cabinets

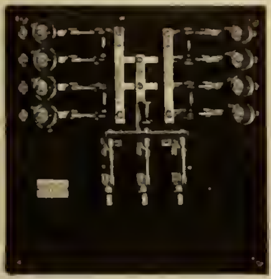


Panel and Box only

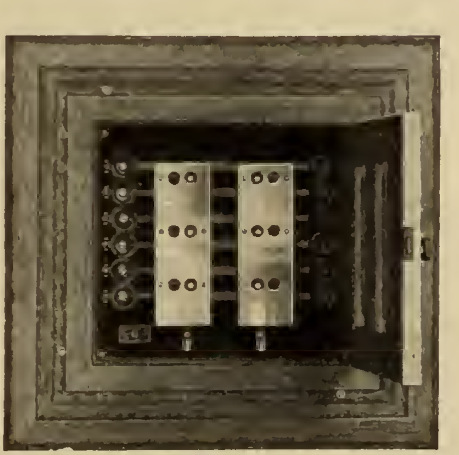


Panel for Enclosed Fuses

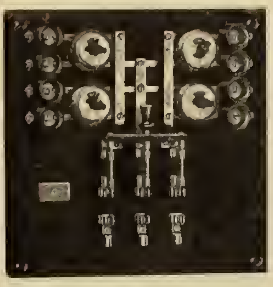
Cabinet Complete (showing knockouts and conduit hole closer)



Panel for Plug Fuses

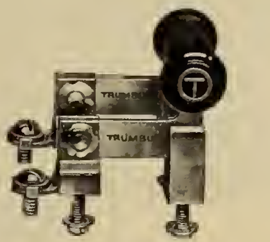


Push Switch Panel and Cabinet complete. The latest in high grade design



Snap Switch Panel

Single Branch Panel



Panel Switch

Push Switch Panel without Cabinet

All newly designed with many valuable adjustable features—all shown in Catalogue No. 10. Get catalogue and investigate.

The Trumbull Electric Mfg. Co.

Plainville, Conn., U.S.A.

Condensed Department

Publisher's Notice

Advertisements under "Situation Wanted" "Situation Vacant" or Miscellaneous, are charged at 2 cents a word per insertion, minimum charge 50 cents.

Advertisements for tenders, equipment, wanted or for sale, etc., are charged at $2.10 per inch.

All advertisements must be in the publisher's hands by the 10th or 23rd of the month to insure insertion in the subsequent issue.

City of Regina, Sask.

Regina Municipal Railway

Tenders

for

Track and Trolley Material

Sealed tenders, registered and clearly marked on the outside of the envelope "Tender for the supply of Street Railway Material" and addressed to the City Commissioners, Regina, Sask., Canada, will be received up to noon, Monday, the 27th day of April, 1914, for the supply of:—

Contract A.
- 100 tons 7-in. tee steel rails, Lorain section 80/335.
- 1,000 track bolts and nuts, ¾ in. x 3¼ in.
- 1,200 copper rail bonds, 10⅛ in.
- 60 copper rail bonds, 42 in.
- 60 copper rail bonds, 62 in.

Contract B.
- 9,000 Barrels Canada Portland Cement.

Contract C.
- 3 miles 500000 c.m. T.B.W.P. 19 stranded Feeder Wire.
- 2 miles 4/0 T. B. W. P. 19 stranded Feeder Wire.
- 10,000 ft. 2/0 hard drawn round trolley wire.

Contract D.
- Trolley frogs, crossovers, line ears, insulators, hangers and pole line hardware.

All material to be delivered f.o.b. Regina, Sask., freight and duty paid.

Copies of specifications, schedules, delivery dates and form of tender and other particulars can be had upon application to H. Doughty, Superintendent, Regina Municipal Railway, Regina, Sask., Canada.

Persons tendering are notified that tenders will not be considered unless made on forms supplied. Forms will be mailed upon request to the Superintendent.

A marked cheque covering five per cent. (5 p.c.) of the total amount of the bid (made payable to the City Treasurer) must accompany each tender.

The Commissioners reserve the right to reject any or all tenders.

R. MARTIN, Mayor,
L. A. THORNTON,
A. W. POOL, City Commissioners. 8

Situations Wanted

Electrician

Position wanted in charge of plant. Experience in steam, hydro, A.C. and D.C. plants. Best references. Address Box 200, Electrical News, 119 Board of Trade, Montreal. 8

Situations Vacant

Trained Mechanic

WANTED—Thoroughly trained mechanic to take charge of the hydraulic inspection and maintenance of a large Hydro-electric plant in the East. Should preferably have had similar experience in some other plant or in the installation of water wheels. State full particulars as to training and experience. Address Box 994, Electrical News, Toronto. 7-8

For Sale

Motor Generator Set consisting of 1¼ h.p. 230 volt, Roth d.c. Motor, directly connected to a 9 amp., 60 cycle, 110-220 volt Generator, complete with regulator, starter and full set of instruments, guaranteed first class in every particular. This set was made one year ago and has been used less than one hour a day for testing very small motors. Price $175.

Reynolds Electric Flasher Manufacturing Co.
7-8 422 So. Talman Ave., Chicago.

Disposal of Patents

The proprietors of letters Patent No. 127080 relating to "Process of Manufacturing Iron Electrodes for use in Alkaline Accumulators," and No. 127081 relating to "Active Masses for Positive Electrodes of Electric Elements, etc.," desire to dispose of the Patents or to grant Licenses to interested parties at reasonable terms with a view to the adequate working of the Patents in Canada.

Inquiries to be addressed to the actual proprietors, Svenska Accumulator Aktiebolaget Jungner, Stockholm, Sweden. 8

Switchboard

For Sale.—Stromberg-Carlson, two position, common battery switchboard, used two years, seventy-five dollars cash. Can be seen at George J. Beattie, 72 Victoria Street, Toronto.

Toronto, April 11, 1914. 8

Wiring Tenders

Tenders will be received up to April 30 for the supply and installation of electrical conduit and wiring required for a large office and warehouse building, Toronto. Plans and specifications may be seen after April 20 at the office of Ewart & Jacob, 306 Kent Building, Toronto.

The lowest or any tender not necessarily accepted. 8

CITY OF FERNIE

Tenders will be received by the city of Fernie, B.C., up to May 6th, 1914, for a complete tungsten street lighting system covering a circuit of nine miles and having 100 candle power lamps and 100 street brackets.

Equipment will include one 10 or 12 kw. tungsten regulator and one panel-board fitted with instruments and switches for control of above series street lighting.

JAMES E. FINN,
Supt. Light and Power.
Fernie, March 20, 1914.

SECOND HAND ELECTRICAL MACHINERY

Bought, sold, rented, and exchanged. We have the largest stock in America. Send for our monthly bargain sheet showing complete stock with our prices.

GREGORY ELECTRIC CO.
CHICAGO, ILLINOIS
Established 1893

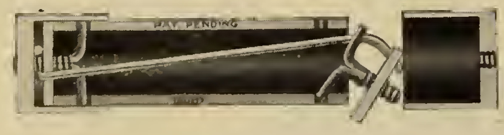
Electrical Machinery

Motors, Dynamos, Generators,
Electrical Pumps and Supplies.
Electrical Contractors.
Motor Repairs.

MAC ELECTRIC CO

52 Queen Street - OTTAWA

DAUM REFILLABLE FUSES



Refilled by simply bending the fuse over the metal cross piece and screwing the cap in place.

No threads on the fibre tube to strip off or screws, rivets or clamps to get loose. Merely two holes in the fibre tube and held in place by the cap. This metal to metal contact is not affected by the swelling or shrinking of the fibre shell.

Daum Fuses are making good every day.

CATALOGUE NO. 17 for the asking

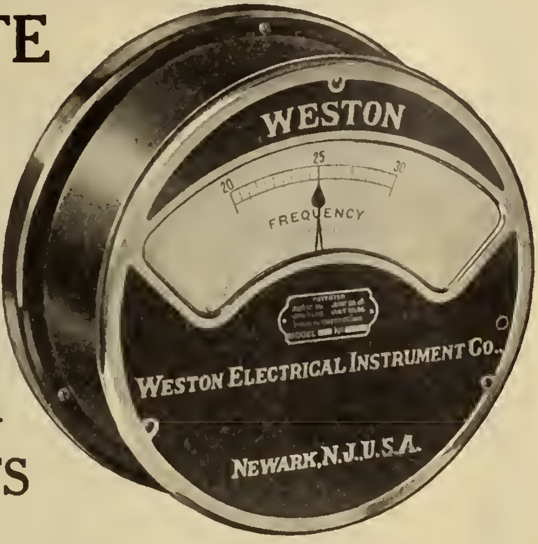
Sole Manufacturers
A. F. DAUM COMPANY, PITTSBURGH, PA.

ASK US about
Efficient
Lighting
for your streets, factory, warehouse or yard

A. H. WINTER JOYNER, Ltd.
76 Bay Street, Toronto
"Consult A Specialist"

INVESTIGATE

WESTON
A. C.
SWITCHBOARD
INDICATING
INSTRUMENTS



We invite full inquiry into the merits of **Weston Power Factor Meters** and **Frequency Meters** and also **Wattmeters, Synchroscopes, Ammeters and Voltmeters** for Switchboard service on alternating current circuits.
Send for catalogs and advise us the kind of instruments in which you are interested, whether for alternating or direct current service

Demonstrations of the operative characteristics of these remarkable instruments may be observed in our New York Office and also in the offices of Selling Representatives in Philadelphia, Chicago, San Francisco and Toronto.

Weston Electrical Instrument Company,

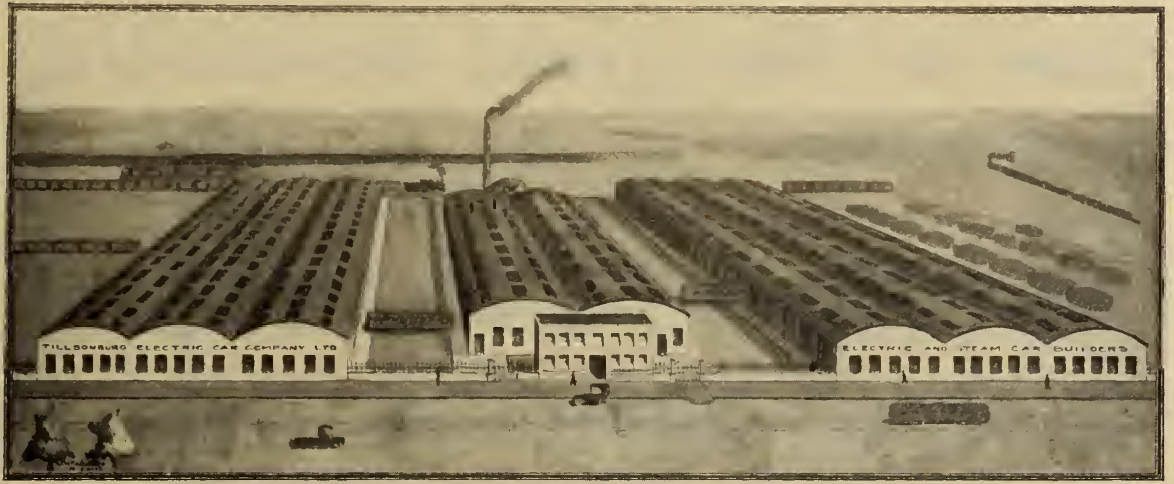
Main Offices and Works
NEWARK, N. J.

New York, 114 Liberty St.
Chicago, 832 Monadnock Blk.
Boston, 176 Federal Street.
Philadelphia, 342 Mint Arcade
Birmingham, American Trust Bldg.

St. Louis, 915 Olive Street.
Denver, 231 15th Street.
San Francisco, 682 Mission St.
Cleveland, 1729 E. 12th Street.
Detroit, 618 Union Trust Bldg.

Montreal, Winnipeg, Vancouver, Calgary } Northern Electric Company, Limited
Toronto, 76 Bay Street.

London, Audrey House, Ely Place, Holborn.
Paris, 12 Rue St. George.
Berlin, Genest St. 5, Schoenberg
Johannesburg, So. Africa, F. Peabody Rice, Standard Bank Building, Harrison St.


TILLSONBURG ELECTRIC CAR COMPANY LTD
ELECTRIC AND STEAM CAR BUILDERS

The Tillsonburg Electric Car Co., Limited

Manufacturers of

ELECTRIC CARS, SWEEPERS AND SPRINKLERS

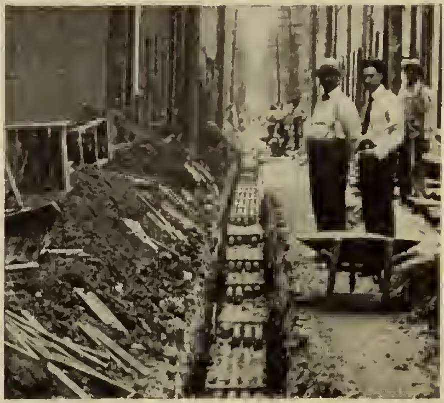
Orders for electric cars are now coming in fast and building operations are in full swing.

Will you need new equipment for summer delivery? If so get in touch with us as soon as possible in order that you may rely on getting your cars when needed.

Office and Works, - - Tillsonburg, Ontario

SEVEN-FOOT LENGTHS

JOINTS 5" LONG—STRONGER AND TIGHTER



Installing a Trunk Line Subway.

American Bituminized Fibre Conduit

is especially adapted for underground Subway, Power House, Telephone and Signal systems, Park and Boulevard Ornamental Lighting installations.

SOME POINTS OF ADVANTAGE:

Long Lengths—5 and 7 feet with socket joints.

Low Cost—two-thirds less than iron pipe, yet it lasts longer.

High Insulation—it withstands a puncture test of 50,000 volts.

Low Absorption—guaranteed less than ¾ of 1 per cent.

May be laid in trench with or without concrete.

Strongest and most durable conduit made—⅜ inch wall, ⅝ in. joints.

Small Sizes a Specialty—1 inch and 1½ inch conduit and fittings.

Electrolysis-proof—water-proof—gas-proof.

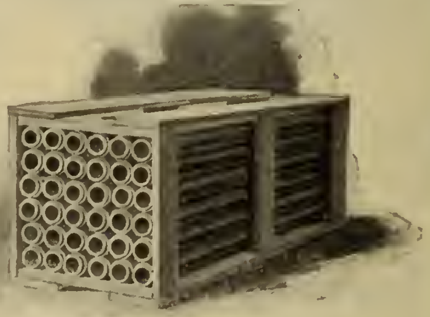
LIGHT WEIGHT—LONG JOINTS—THICK WALLS

Send for interesting and valuable booklet "Underground Conduit Construction" Free.

AMERICAN CONDUIT CO.
EAST CHICAGO, INDIANA, U.S.A.
140 Nassau Street, New York, U.S.A.

Distributors for Canada:

Northern Electric Company
LIMITED
Montreal Halifax Toronto Winnipeg Regina
Calgary Edmonton Vancouver Victoria



180 ft. 1-in. Conduit. Wt. 192 lbs.

One of the great developing Powers of the Country

Copper and Galvanized Strand Wire

Hydro-Electric Systems

Pole Line Hardware
Black and Galvanized

We specialize in the equipment for Hydro-Electric systems also for Telephone and Telegraph Circuits.

Write for information to

The Steel Company of Canada, Limited

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Western B.C. Cedar Poles

Western Lumber and Pole Co
Cedar Poles Posts

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Denver, Colo.
B. F. Vreeland, Pres.

Branch Office:
Spokane, Wash.
G. C. McDonald, Supt.

J. W. Orr, Head Inspector
For Provinces
Grand Forks, B.C.

Geo. Prichard, Head Inspector
For States
Newport, Wash.

31 Cedar Yards in B.C., Wash. and Idaho

☞ We have shipped **B.C. Cedar Poles** to all points named below: Those to Ontario mostly for

The Hydro-Electric Power Commission of Ontario

Alberta
Calgary
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Quebec
City Quebec
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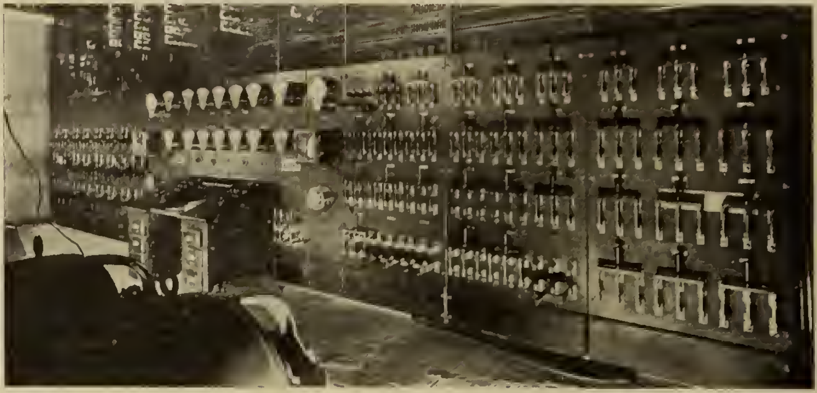
We have EXTENSIVE STOCKS of B.C. CEDAR POLES of all sizes to take care of our customers in the CANADIAN PROVINCES.
If your "Town" don't show in the above list send us your inquiries and orders that we may add it.
WRITE OR WIRE

Western Lumber & Pole Co.

Main Office - Denver, Colo. - "Electric" Bldg.

Switchboards and Panels

Marked "Metropolitan" are the best that can be produced



FEEDER PANELS AND DESK BOARD, LORD & TAYLOR STORE, NEW YORK

We furnished the new Lord & Taylor Building with the remote control generator switchboards, having a desk board controlling the isolated generator panels. We also furnished the auto charging and dead front switchboards; power and light panel-boards, detachable mechanism, flush switches and receptacles.

TRADE **METROPOLITAN** MARK
ELECTRIC MFG CO.

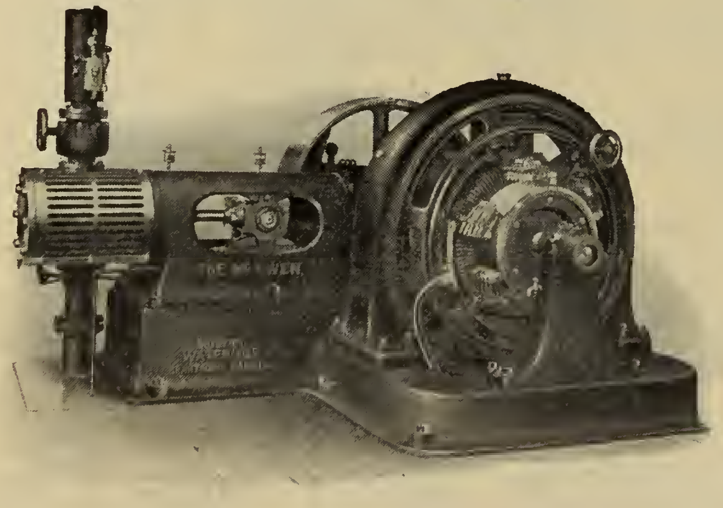
CANADIAN AGENTS:

ECONOMY ELECTRIC CO.

Bank of Hamilton Building **Yonge and Gould Sts., TORONTO**

McEWEN ENGINES

For the Isolated Plant



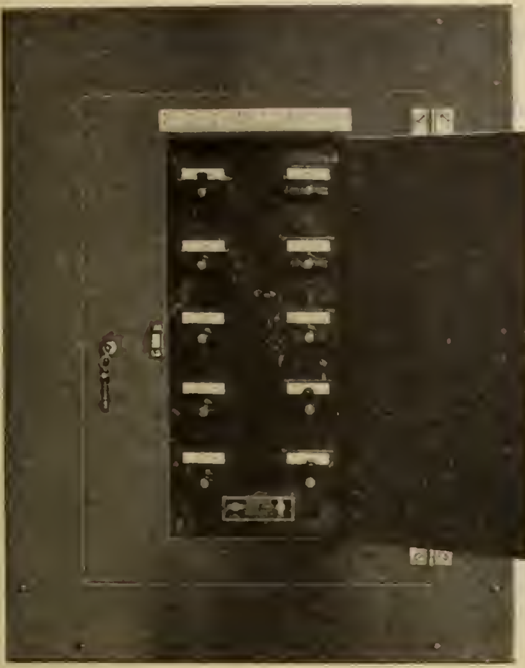
The McEwen High Speed Automatic Engine in your engine room is your best guarantee of continuous satisfactory service.

There are no shut-downs because "something has gone wrong on the transmission line."

Economical operation and the ability to be on the job every working day in the year, has placed the McEwen in hundreds of isolated plants in this country.

Ask for our list of Canadian users. It is the best selling argument we can show you.

The Waterous Engine Works Co., Limited BRANTFORD, CANADA



SAFETY PANEL

KRANTZ

Safety Panels
Panel Boards
Metering Panels
Knife Switches
Switch Boards

Of standard and special design for all requirements.

OUR ENGINEERS ARE AT YOUR SERVICE.

May we send you our Bulletins?

THE CANADIAN KRANTZ ELEC. & MFG. CO., LTD.
67-71 Adelaide St. West **TORONTO, ONT.**

Washing by Electricity

BIG PROFITS for DEALERS

With cheap electric power now being so accessible throughout Canada and so widely used, dealers make good money by handling the "1900" Electric Washer.

These Electric Washing Machines are creating for dealers handling them, a big **additional business.** It is a line that every Electrical Dealer in Canada can make money out of and should take up at once.

"1900" Washers have been heavily advertised and are known from Coast to Coast.

Wringing by Electricity

Window Attracts Big Crowds

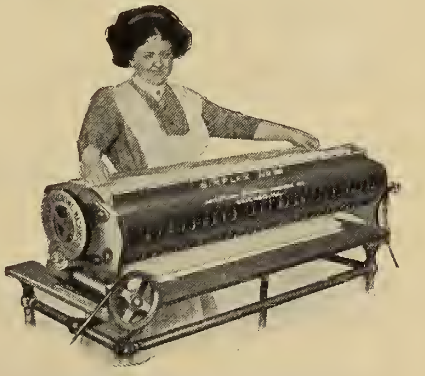
The Toronto Hydro Electric Shop demonstrated a "1900" Electric Washer Wringer and Ironer outfit in operation in their window for one week and attracted such crowds that a special policeman had to be on duty to keep the sidewalk clear.

We will arrange similar window demonstrations for Dealers taking up our proposition.

Write at once for terms and territory.

W. K. H. Morris, Manager

1900 Washer Co.
357 Yonge St., Toronto, Ont.



Self Heated Ironer, Motor driven

7500 Kw. Westinghouse-Parsons Turbo-Generator Unit

For Immediate Shipment. **Can be seen in Operation.**
Excellent Condition Electrically and Mechanically.

Turbine. 750 r.p.m. Designed for 150-200 lbs. working pressure, single flow, with high, intermediate and low pressure stages, direct coupled to

Generators. One 7500 KW. Westinghouse, 3-phase, 25 cycle, 6600 or 2300 volt, revolving field type, and One 7500 KW. Westinghouse, 3-phase, 60 cycle, 6600 or 2300 volts, revolving field type.

On a common bed-plate in three sections. The set is complete with Alberger Surface Condenser, pumps and complete condensing equipment.

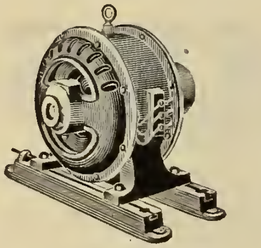
This unit is designed to deliver an output of 7500 KW. at 25 Cycle, or 7500 KW. at 60 Cycle, or an aggregate of 7500 KW. in 25 Cycle and 60 Cycle current.

By disconnecting one of the generators we can sell it either as a straight 25 Cycle or a straight 60 Cycle outfit, if preferred.

The above described equipment is ideal to hold as a reserve outfit for the reason that it can be purchased at a very low price because it must be moved immediately. It can be seen in operation for the next two or three weeks.

MACGOVERN AND COMPANY, Inc.

FRANK MACGOVERN, Pres.-Gen. Mgr. JOHN MAYER, Jr., Vice-Pres.-Treas.
114 Liberty Street, New York City. 'Phone 3375-3376 Rector.
Complete list of A. C. and D. C. Apparatus, Engines, etc., will be sent on application.



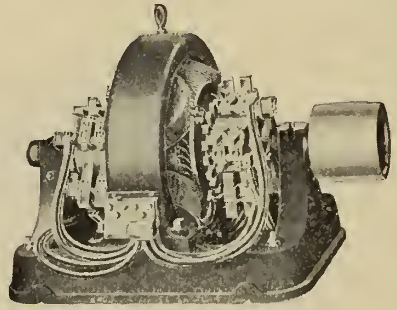
We are Manufacturers of

Motors, Dynamos, Motor and Gas Generator Sets and Special Machinery

Our Prices Are Right

A high priced article may not necessarily be the best. Our aim is to produce a high class article at a reasonable price.

We guarantee all our work.



Our Service the Best

Our additional flow space which is now in course of construction will more than double our former capacity. This means better service.

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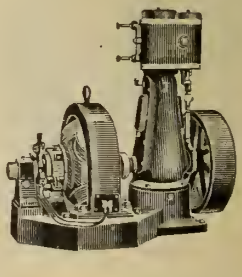

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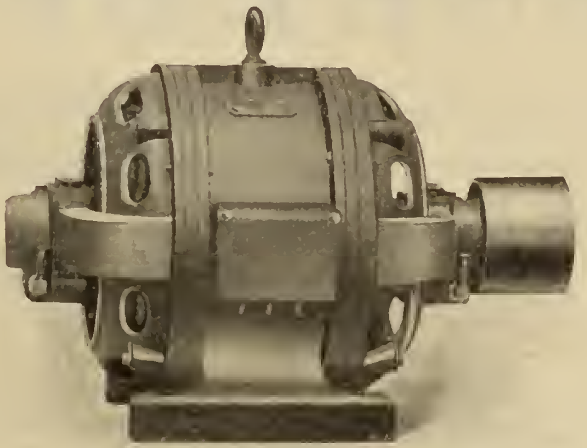

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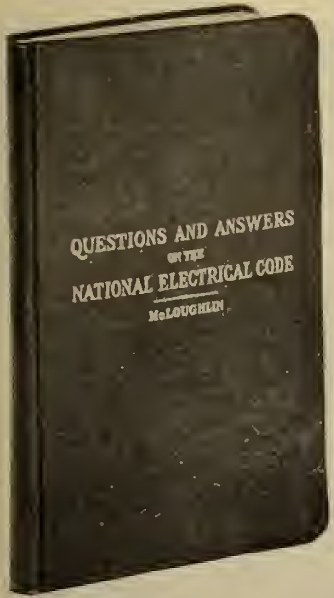

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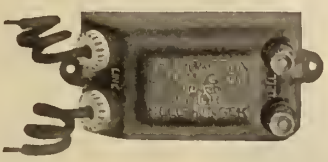

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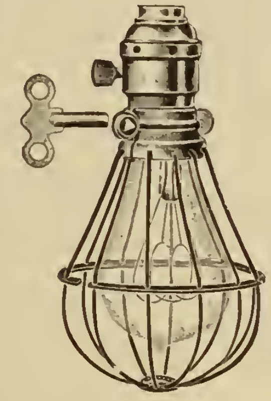

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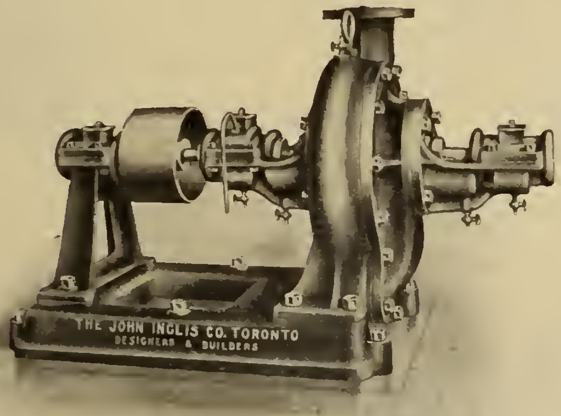

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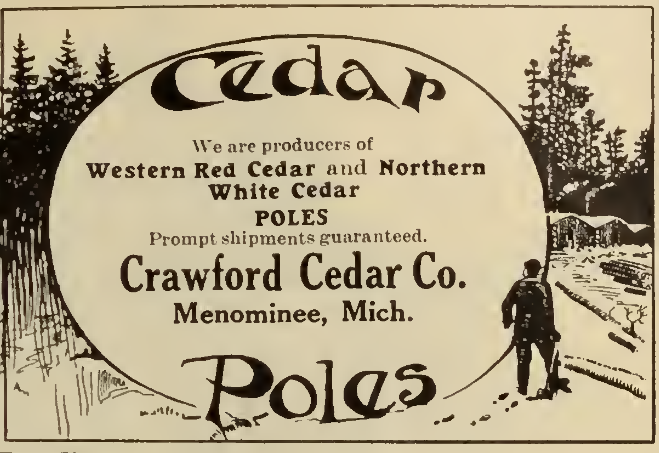

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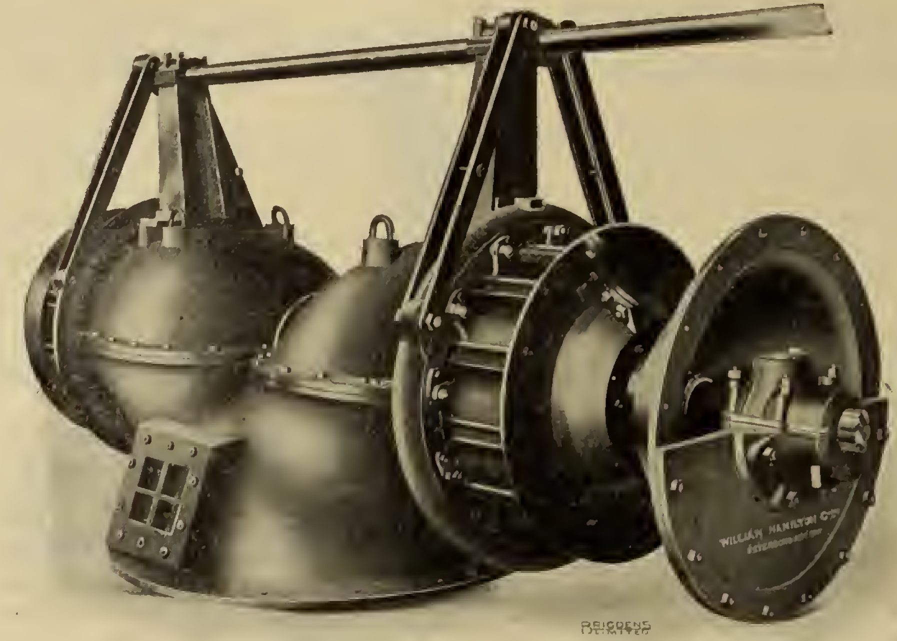

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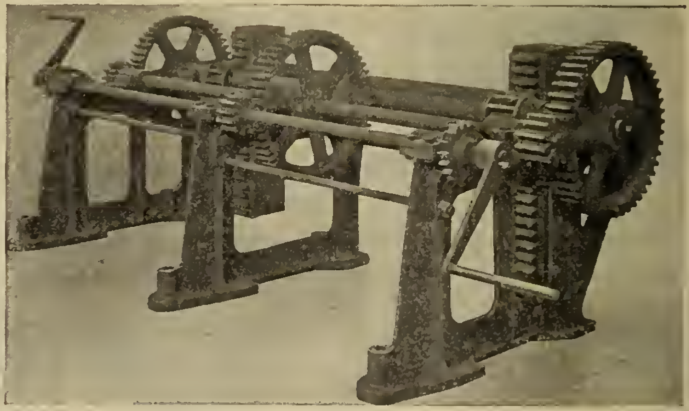

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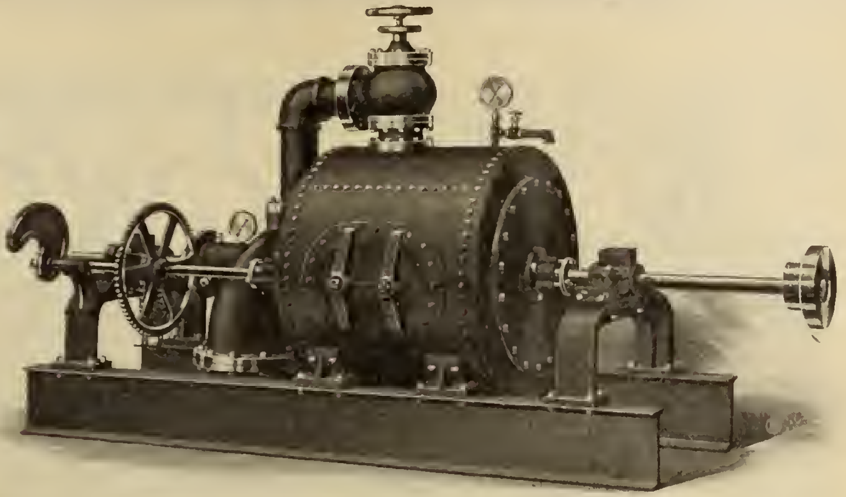

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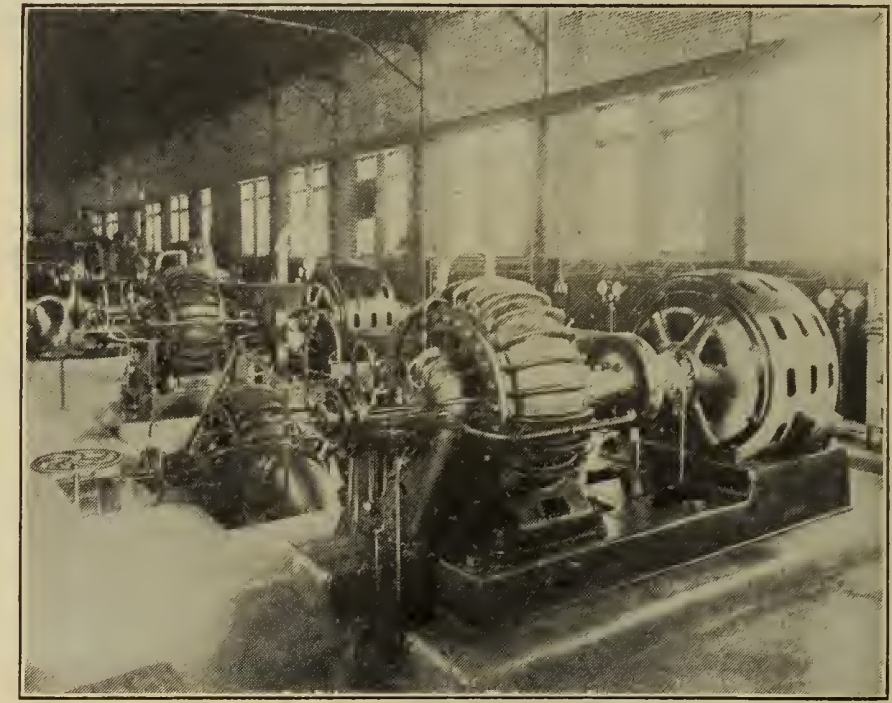

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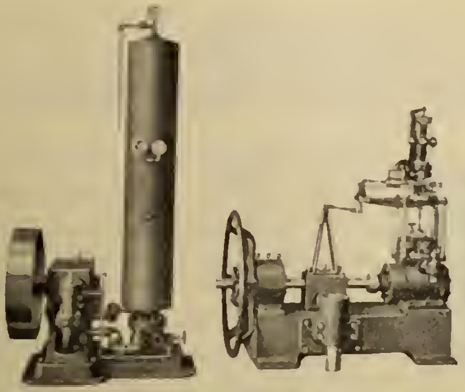

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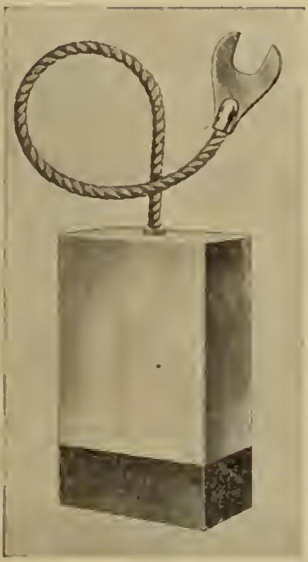

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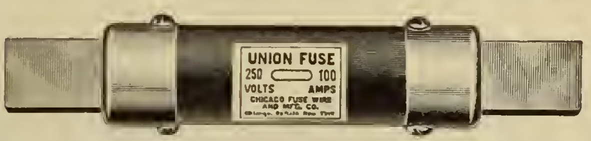

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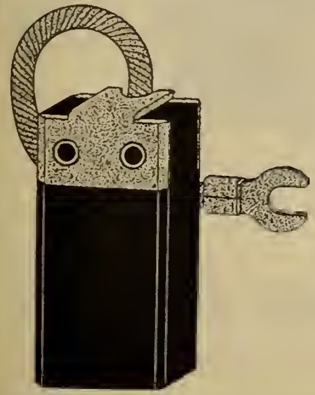

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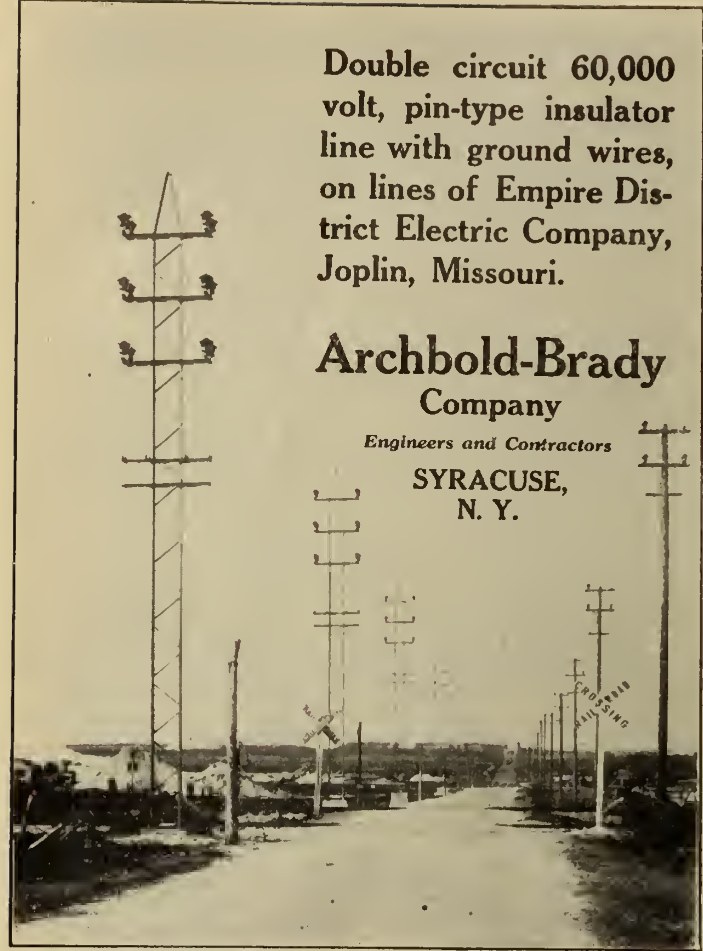

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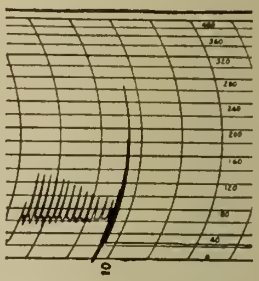

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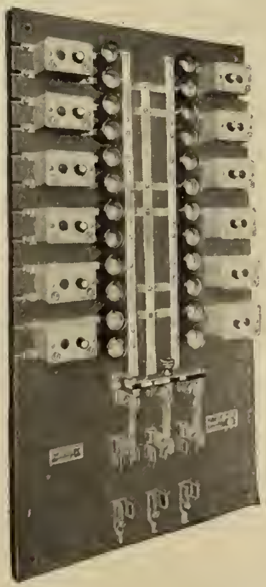

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ST. LOUIS, MO., U. S. A.

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The Important Factor in Fare Collection

Satisfaction Guaranteed

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are admitted the perfection of cooking equipment. Free from ashes—require no fuel—cause no heat. Economical and practical.

Send for booklet 4 recipes for Happiness

SIMPLEX ELECTRIC HEATING CO.

Mfrs. of Everything for Electric Heating and Cooking

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Member of THE RICE LEADERS OF THE WORLD ASSOCIATION

DOSSERT CONNECTORS

besides increasing efficiency and safety, save time and labor on installation costs. Used for connections to panel boards, switchboards, busbars, switch and control gear, generator, converter and transformer apparatus, motors, and all shop wiring and apparatus.

DOSSERT & CO., 242 West 41st St., NEW YORK

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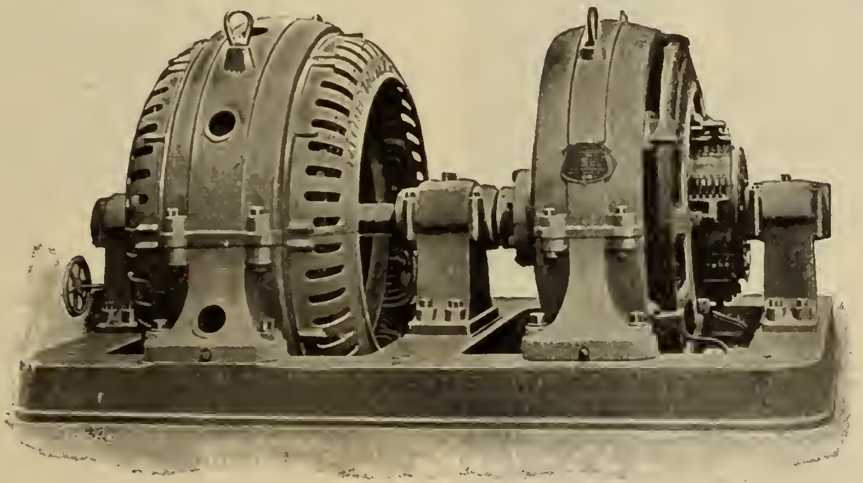
IRVING SMITH. Canadian Rep., Unity Bldg., MONTREAL

Electric Motors for all Purposes

Curve Drawing Meters. Portable Type for Factory Use

The
"Lancashire"
Ball Bearing
Induction
Motor

The
"Lancashire"
Patent Reversing
Drive for
Metal Planers



Motor Generator—300 K.W. for Traction Service.

The Lancashire Dynamo and Motor Co. of Canada, Ltd.

Montreal 107-109 Duke St., Toronto

REPAIRS — REWINDS — RE-DESIGN

Send in that broken down machine and have us give you a price to make it good, nothing too small and nothing too big. You know the old slogan "A stitch in time saves nine" it holds good with your plant, a new coil dropped in your machine at the right time saves rewinding it.

We also re-design both A. C. and D. C. motors for any pressure. Special Transformers, Switchboards, etc; Built to order.

The Electrical Engineering Co. of Toronto

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One of a hundred adaptations of the

Campbell Automatic Time Switch

Switches any light, all lights, any time you wish.

Weather tight, gas tight, tamper tight—and you visit it once in 8 days.

Campbell Electric Co.

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Electrical Supplies

Warehouse Space

Adelaide St. W., Toronto

This new warehouse building will be well suited for the displaying and stocking of electrical supplies.

When completed this will be the most attractive warehouse building in the city. The exterior, the entrances, the elevators, etc., bear all the earmarks of a high class office building.

Special Features

Centrally situated
Light on four sides
Passenger and freight elevator
Vaults
Low insurance
One block from four car lines
Floor area, 6,300 sq. feet, each floor.
Building ready for occupancy May 15th.

For further particulars ask

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Rubber Covered Wires and Cables

FOR POWER, LIGHT AND TELEPHONE WORK

Incandescent Lamp Cord, Flexible Switchboard Cables, Special Cords and Cables for all kinds of Electrical Work.

Prompt Shipments from Canadian Factory.

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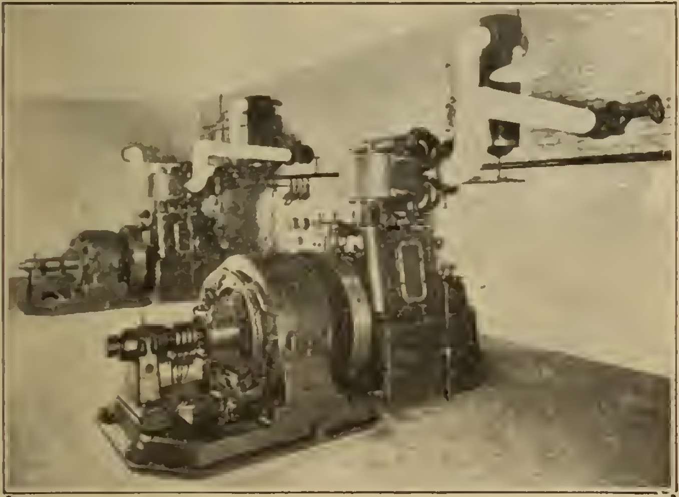
Canadian Office and Factory, HAMILTON, ONT.



Showing Engine Room of New Toronto Central Y.M.C.A. Equipped with two G. & Mc.C. Vertical Quick Revolution Steam Engines.

G. & McC. Verticals

have a superior system of Forced Lubrication.
Are fitted with combined Throttle and Expansion Governor.
Are Economical in their Comsumption of Steam
Require Little or No Attention while Running.

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Head Office and Works - - GALT, ONT., Canada
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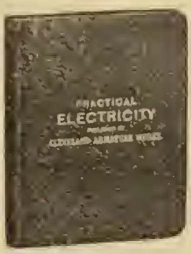
ELECTRICAL MACHINERY

AND REPAIRS

Armatures Complete
Armatures Rewound
Armature Coils
Armature Shafts
Field Coils

Commutators New, Refilled or Assembled



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Kingston, Ont., Canada

Miners, Exporters and Dealers in Canadian Amber Mica.

Thumb Trimmed, Cut to Size, Splittings, Discs, Washers, Etc.

Write us for prices and let us figure on your requirements.

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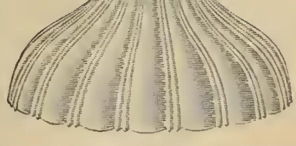

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PHILADELPHIA

ILLUMINATION PROBLEMS

carefully executed

by

A LIGHTING SPECIALIST

See us about House Wiring. Main 3067.

Electric Lighting Specialists Co.

Room 304A Tyrrell Bldg., 95 King St. E., Toronto

J. C. Salvaneschi, Manager.

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Electrical
Conductors

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Ingot Sheet
Wire Rod
Tubing

**Northern
Aluminum
Company**

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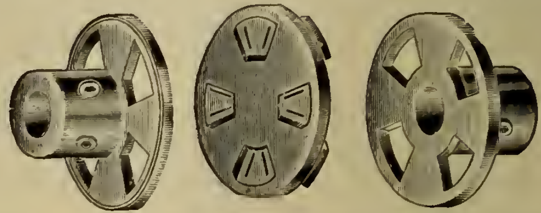
A few dollars spent in advertising your proposals in

The Contract Record

would result in additional competition, which might save your city or town or your client many hundreds of dollars.



This Simple Insulated Coupling

is flexible enough to work perfectly where the shafts are not in alignment. Small but powerful—stands sudden strains. It's called the Grundy Flexible Insulated Coupling.

Canadian Bond Hanger & Coupling Co.,

Alexandria, Ont. Limited

MORRIS CHAIN-BLOCKS,

**DUST-PROOF,
WEATHER-PROOF,
FOOL-PROOF.**

THE HERBERT MORRIS CRANE & HOIST CO.

LIMITED,

EMPRESS WORKS,
PETER STREET,
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BRANCH OFFICE,
CORISTINE BLDG.,
MONTREAL QUE.

FELTS

Dust and Oil Rings, Buffers, Lubricating Pads, Wicks for Fan Motors, and felts of every kind for electrical and mechanical uses.

The Booth Felt Co., Limited

GANANOQUE, ONT., CANADA

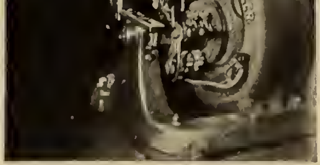
The Jordan Commutator Truing Device

Operates without removing armature. No shut down of motor or generator.

No large cuts from commutator and no unnecessary waste of copper.

No dragging of copper causing short circuits.

No portable slide-rest with the danger of the tool digging into the commutator and numerous other chances of damage to the commutator or armature which are all overcome with this machine.


TYPE J DEVICE ATTACHED TO
15 HP. CROCKER WHEELER MOTOR
BACK VIEW OF TRUING DEVICE:
CROCKER WHEELER

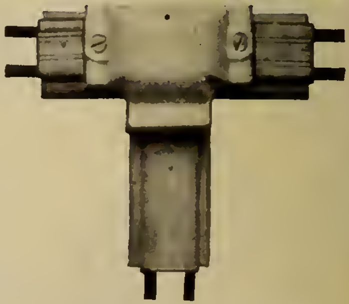
JORDAN BROS., Inc., 74 Beekman St., New York

Represented by: Frank E. Filer, Winnipeg, Can.

The Jordan Tapon for Moulding Work

A real time saver which means a Money Saver, making the best class of work.

It is not necessary to have the ends of the capping straight as the cover of the Tapon overlaps the capping, thereby covering any bad ends of capping.



JORDAN BROS., Inc., 74 Beekman St., New York

A. Hall Berry, General Sales Agent, 97-99-101 Warren St., New York City

"NATIONAL"

"Mantel Type" ELECTRIC RADIATOR

SIZES—24" x 30"—3 lamps; 30" x 30"—4 lamps.

EVERY wide-awake contractor and electrical supply house should handle the "NATIONAL" Mantel Type Radiator. It's a winner and a money maker.

Made in standard sizes and finishes. We also manufacture a complete line of portable radiators and air heaters from 650 watts to 10,000 watts capacity in any voltage.

It will pay you to get our prices and descriptive literature.

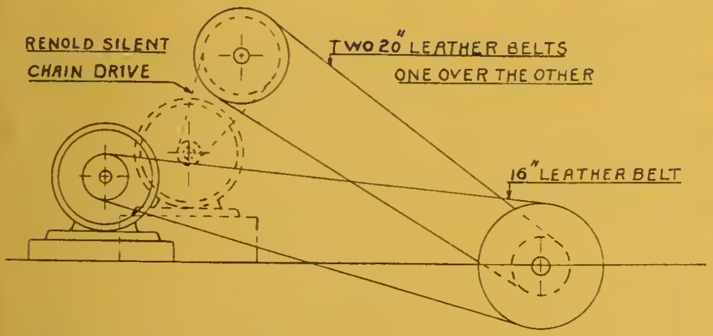
There is a "NATIONAL" heater for every requirement

The National Electric Heating Co., Limited

TORONTO - - ONTARIO

Hans Renold Patent Liner Silent Chain

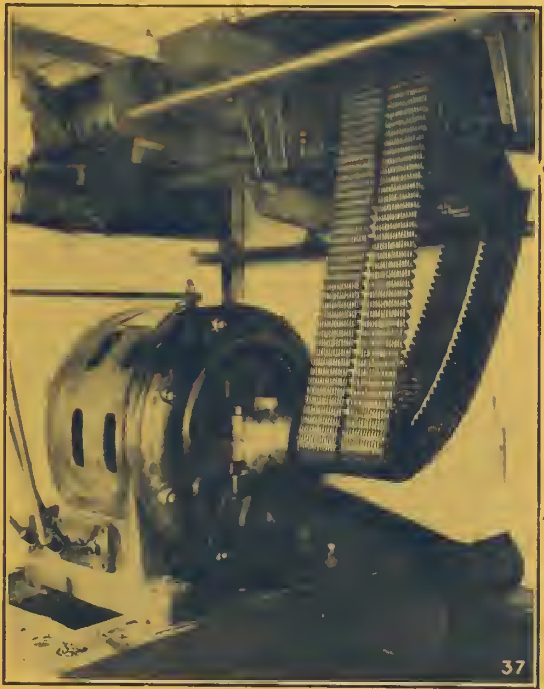
"The Power-Saving Transmission"


RENOLD SILENT CHAIN DRIVE
TWO 20" LEATHER BELTS ONE OVER THE OTHER
16" LEATHER BELT

100 HP DOUBLE REDUCTION BELT DRIVE REPLACED BY RENOLD SILENT GEAR (SHOWN DOTTED IN) ㊸

Intending users of Hydro-Electric Power **MUST LOOK** to the means of power Transmission. Otherwise tremendous losses will follow. The above cuts show a double reduction belt drive—with which the input to Motor was 125 h.p.—and the chain drive which substitutes it. With the chain drive the load on the lineshaft was increased and the input to the Motor reduced to 95 h.p. or 31 per cent. This saving at $15.00 per h.p. per year amounts to $450.00 regardless of increased production, saving of space, etc.

Have You Any Such Losses?



The Renold Chain Drive as shown in drawing opposite

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JONES & GLASSCO, Engineers, (Reg'd.) **Sole Canadian Agents** **MONTREAL**

Branch Office: TORONTO ***We stock Chain and Repairs***

The Hydro-Electric Power Commission of Ontario, approves "Detroit" Ironclad Entrance Switches because they are best.

- "Detroit" Entrance Switches offer the greatest possible protection and at the same time the greatest ease of operation.
- Accidental contact with live parts impossible.
- Switch and Cutout enclosed in iron box.
- Cover of box may be sealed or locked shut.
- Switch may be sealed or locked "off."
- Switch operated from outside of box, without exposing live parts.

2 Pole 30 Amp. 125 Volts.
Also made in
other sizes.

Send today for Bulletin 27.

BENTZ-RICHARDSON CO., LIMITED
Western Canadian Agents
114 Phoenix Block, WINNIPEG, MAN.

McNAUGHTON-McKAY ELECTRIC CO., LTD.
Eastern Canadian Agents
216 Wyandotte St. East, WINDSOR, ONT.

Detroit Fuse & Manufacturing Company
1404 Rivard St., DETROIT, MICH.

— the tale that tells

Over six thousand meters installed on Hydro lines. In spite of heavy surges and other rigorous conditions not one potential coil has broken down. *How many potential coils do you replace each year?*

Why not buy a meter that will give you this assurance of reliable service? That meter is a *C & H Meter.*

Send us a sample order—yes, send a rush order—and we will amply prove these statements to you as well as demonstrate the prompt service which is at our customers' disposal.

This illustration shows our single phase meter. We also have in stock for prompt shipment, polyphase, two-rate and prepayment meters.

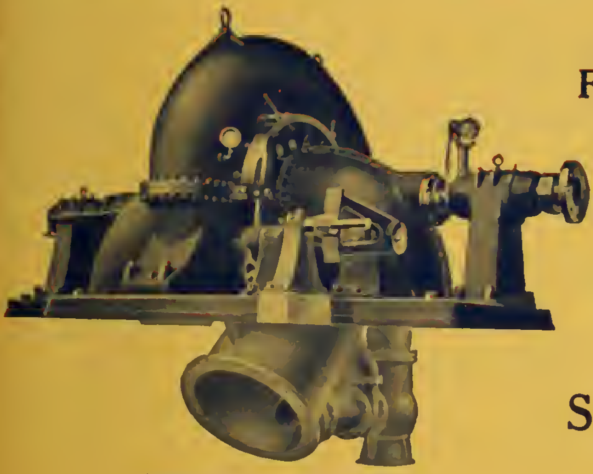
Chamberlain & Hookham Meter Co., Ltd.
TORONTO 120 Richmond St. W. ONTARIO
Spencer & Aspinall, 617 New Birks Bldg., Montreal, P.Q.

Vol. XXIII—No. 9

Toronto, May 1, 1914

Electrical News

Generation, Transmission and Application of Electricity



5250 Horse Power 275 Feet Head

90% EFFICIENCY

From SMITH HYDRAULIC TURBINES

Recent tests at Holyoke, Mass. of Smith Turbines have again proven their superiority over any turbine now manufactured.

These tests showing efficiencies from 89% to over 90%.

We design and build turbines for heads from 5 feet to 650 feet.

Send for Bulletin N

S. Morgan Smith Co., York, Pa.

Branch Offices: 176 Federal St., BOSTON, MASS.
614 American Trust Bldg., CHICAGO

SAFETY FIRST ECONOMY renewable cartridge FUSES

ECONOMY renewable cartridge FUSES

Made in Canada and sanctioned by the Canadian Fire Underwriters' Association.

SAFETY FIRST - - - - ECONOMY NEXT

Economy Fuses are safe under all conditions. They never hold a sustained arc nor vent fire. The only renewable fuse that is uniformly rated.

Eighty per cent. of annual fuse maintenance expense over the cost of using non-renewable fuses is saved when Economy Fuses are employed.

WRITE TO-DAY FOR BULLETINS, PRICES, AND DISCOUNTS.

Economy Fuse & Mfg. Co. of Canada, Limited, Herald Building
Montreal

"Look for the Gray Shell"

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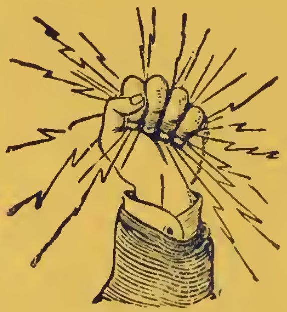
PHILLIPS



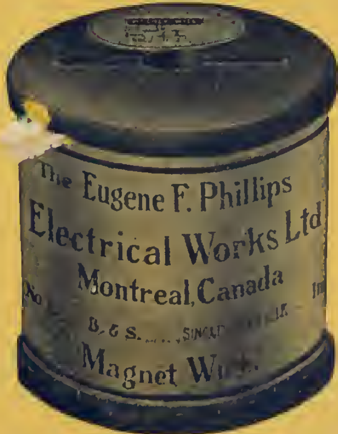
Bare and Insulated Copper

WIRES AND CABLES

For Telephone, Telegraph, Lighting,
Power and Street Railway Equipment

Bare and Insulated Electric Wire and
Cables for Aerial and Underground use

Railway, Feeder and Trolley Wire



Weatherproof Magnet
and Rubber Covered
Wires and Cables

Incandescent and Flexible Cords

Eugene F. Phillips Electrical Works, Limited

MONTREAL - - CANADA

Branches: Halifax, Toronto, Winnipeg,
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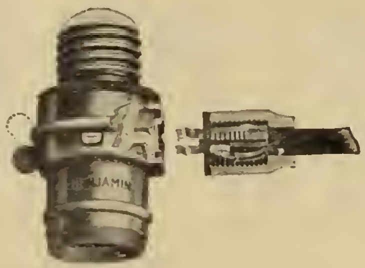
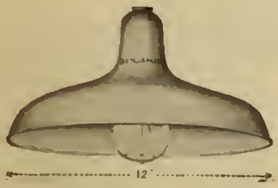
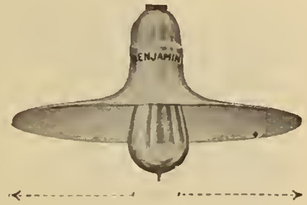




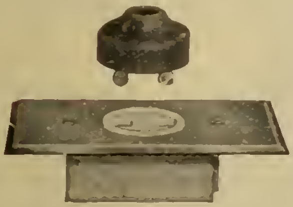


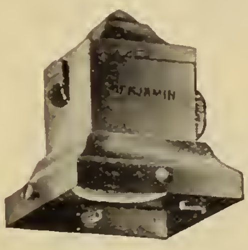
Better Your Business With Benjamin Quality

Built to Stay on the Job

Sockets	Fixtures
Rosettes	Reflectors
Cutouts	Fittings
Clusters	Switches

Knife Switches
Insulating Joints
Dim-a-Lites

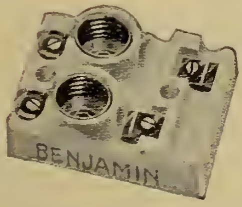


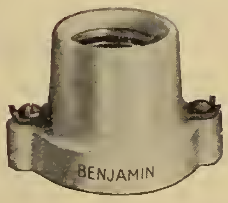


SPECIFY
"BENJAMIN"
ON YOUR NEXT ORDER

Write for Cat. C-21

Benjamin Electric Mfg.
Co., of Canada, Limited
TORONTO, ONT.





BRUCE PEEBLES

ELECTRICAL MACHINERY

FOR ALL PURPOSES

500 KW A.C. ALTERNATOR

Generators, Motors, Peebles-La Cour Motor-Converters, Motor Generators, Rotary Converters

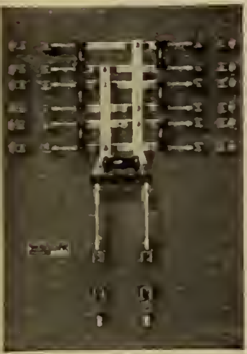
FERRANTI ELECTRICAL COMPANY OF CANADA
LIMITED

90 Sherbourne St.
TORONTO

Farmer's Advocate Bldg.
WINNIPEG

Panel Boards and Cabinets

That Embody Advanced Structural Principles. Material and Workmanship the Best.


Type A Panel

Type H Panel

OUR line of Panel Boards includes four distinct types, each made in single and double branch forms, with mains carrying lugs only, fuses, fuseless knife switch, and fused knife switch for 2 to 2 and 3 to 2 wire systems. Three to 2 wire Panel Boards are made in convertible form as well as the standard construction.

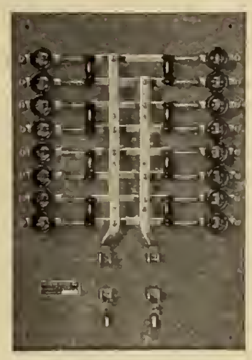
Type "A" Panels [125 and 250 volts]—Branches arranged for enclosed fuses and with or without knife switches.

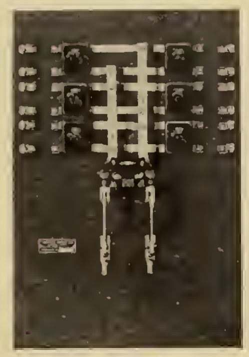
Type "D" Panels [125 volts] — Branches arranged for plug fuses and with or without knife switches.

Type "F" Panels [125 and 250 volts] — Branches arranged for enclosed fuses and snap switches.

Type "H" Panels [125 volts]—Branches arranged for plug fuses and with snap switches.

Our designs in Cabinets embrace fifteen types—all steel, steel and wood combined and wood with slate lining, either for flush or surface mounting and with side or back gutters, also without gutter.


Type D Panel


Type F Panel

Type M Cabinet

Type DFP Cabinet

Type ESQ Cabinet

Type CL Cabinet

If your dealer does not stock them, write us.
"Panels and Cabinets, Bulletin No. 1 sent free upon request.

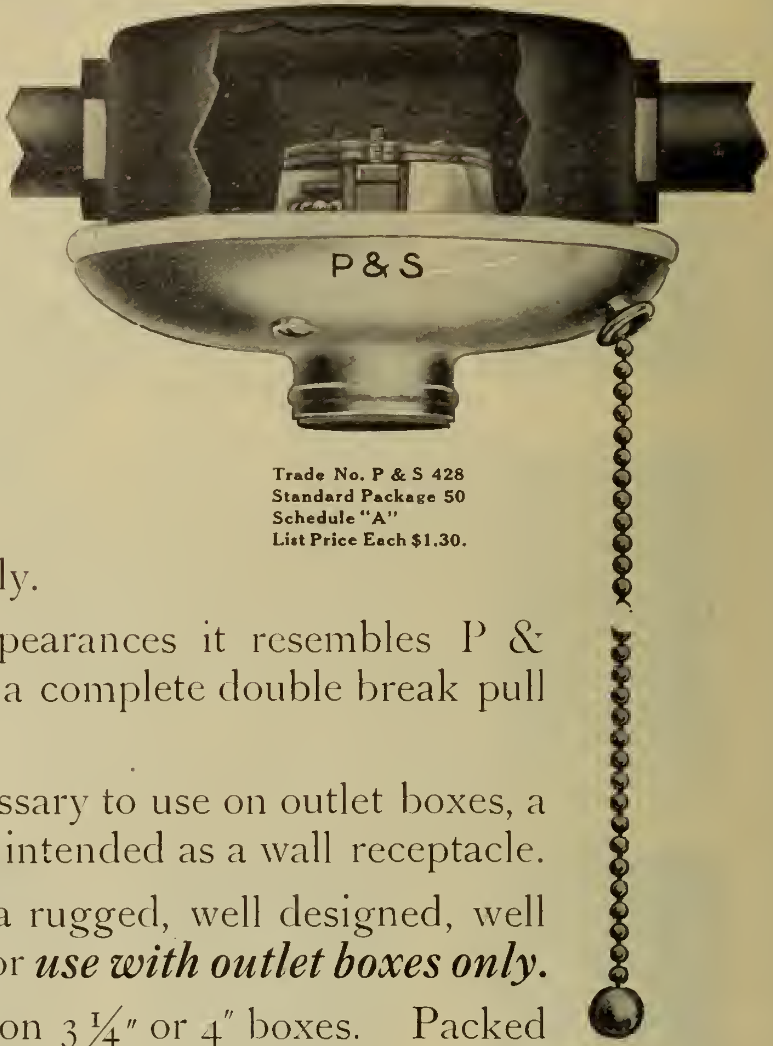
Crouse-Hinds Co. of Canada, Ltd.

Main Office and Works:

Toronto, Ontario, Canada

Kindly send me free copy of Bulletin No. 101.
Name..
City..
Prov..
21013

Something Different and Better



Trade No. P & S 428
Standard Package 50
Schedule "A"
List Price Each $1.30.

It would seem that the 58 different receptacles we make for outlet boxes would cover the field, but here is a new one recently evolved by our engineers.

And it's a dandy.

In outward appearances it resembles P & S 10, but it contains a complete double break pull mechanism.

No longer necessary to use on outlet boxes, a pull receptacle really intended as a wall receptacle.

P & S 428 is a rugged, well designed, well built pull receptacle for ***use with outlet boxes only.***

It may be used on 3 ¼″ or 4″ boxes. Packed one in a paper carton, each carton containing the screws to fasten to outlet box.

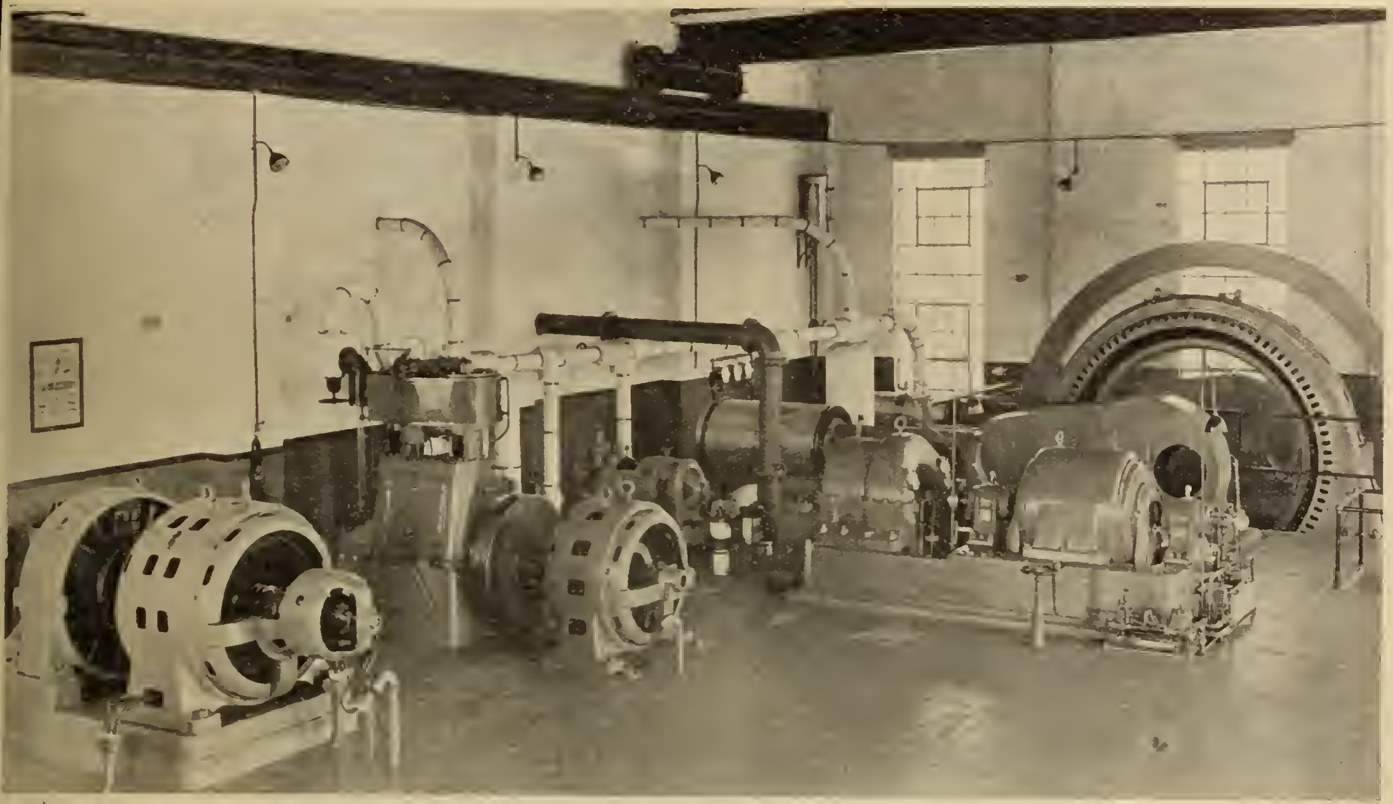
Each receptacle is supplied with 6 inches of chain to which is attached 10 feet of black cord complete with ball.

Your Jobber is now ready to fill your order from stock.

Pass & Seymour, Inc.

Main Office and Works, Solvay, New York, U.S.A.

San Francisco — Rialto Building



New plant of Sarnia Gas & Electric Company.

The following apparatus was installed by Swedish General Electric, Limited:

1—500 KVA, 3600 RPM, turbo-generator.

1—375 KVA, 100 RPM, engine type generator.

1—190 KVA, 450 RPM, engine type generator.

1—300 KW, 720 RPM, auto-synchronous motor generator set.

1—150 KW, 720 RPM, auto-synchronous motor generator set.

1—Eight panel switchboard.

THE SWEDISH GENERAL ELECTRIC, LIMITED

Head Office—TORONTO

Branch Offices—MONTREAL General Supplies Ltd., CALGARY, Alta.

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GALVADUCT

C. P. R. Banff Springs Hotel
A GALVADUCT Building in the heart of the Rockies

"GALVADUCT"

The most perfect interior construction conduit on the market.

Recognized as the standard of high quality.

Always specify Galvaduct or Loricated conduits

"LORICATED"

A high-class interior construction conduit of the enamelled type, proof against acid or other corrosive agents.

If your jobber cannot supply you—write us

Conduits Company Limited

Toronto - Montreal

USED IN THE NEWEST BUILDINGS

LORICATED

Why Not Buy Canadian made Meters?

Our Improved
Type "K" Meter.

Packard

"Packard" Meters have been manufactured in Canada for the past fifteen years.

There are over 70,000 in use at the present time throughout Canada.

Government re-inspections have proven the "Packard" to be a meter that will ***stand up*** and retain its accuracy of calibration over years of service.

Our improvements are all up-to-date and there is no better meter made anywhere.

The "Packard" may cost a little more at the start, but it saves money in the end.

Showing Improved
Magnet Support.

LARGE STOCKS CARRIED AT

St. Catharines and Winnipeg;
St. John Railway Co., St. John, N.B.;
General Supplies, Limited, Calgary, Alta.;
Rudel-Belnap Machinery Co., Canadian Express Bldg., Montreal, Que.

The Packard Electric Co., Limited

Factory at St. Catharines, Ont.

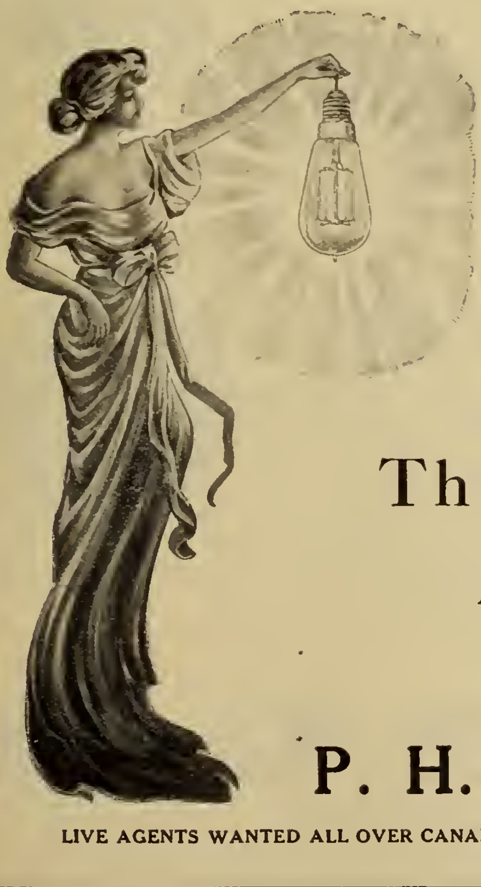
General Sales Office,
Traders Bank Bldg., TORONTO

N. W. Office and Warerooms,
WINNIPEG

G. M. Gest

Conduit
Engineer & Contractor

503 Power Building, Montreal, Can.



NEWTYPE
BERGMANN
LAMPS
(Tungsten Filament)

The Unbreakable Kind

Are Now Ready for Delivery

We guarantee delivery to you in good condition

EXCLUSIVE CANADIAN DISTRIBUTORS

P. H. KLEIN CO.,
LIMITED

23-25 DOWD STREET,
MONTREAL, P.Q.

LIVE AGENTS WANTED ALL OVER CANADA

No. 6052—18 in. diameter

No. 9070— 7 in. diameter, 4 in. Fitter
No. 9072—10 in. diameter, 5 in. Fitter
No. 9074—12 in. diameter, 6 in. Fitter
No. 9076—14 in. diameter, 9 in. Fitter
No. 9078—16 in. diameter, 10 in. Fitter

No. 4070—10 in. diameter
No. 4071—12 in. diameter
No. 4072—14 in. diameter
No. 4073—16 in. diameter
No. 4074—18 in. diameter

MOONSTONE and Cut Lighting Glassware

No. 994 C 101

No. 441 C 410

is always used where Luxurious and Efficient Lighting is wanted.

The Toronto Hydro-Electric System found by test that MOONSTONE Glass gives results superior to any other glass made.

MOONSTONE Glass has been adopted for the complete Street Lighting service in Toronto and many other cities in Canada.

No. 1045 C 305

No. 446—6 in. Ball C 114

Jefferson Glass Co., Limited

Toronto, Canada

A Profitable Proposition
for Canadian Dealers

Investigate the profit possibilities in handling the "Connecticut" line. For 20 years we've specialized on this class of work and today the name "Connecticut" on an electrical instrument stands for superior quality and reasonable price.

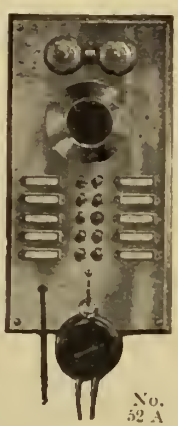
Type "L" made in all sizes and styles.

Handle this line in your section — there's worth-while profit in it for you. Write for full particulars.

CONNECTICUT

Electric Reset Annunciators and Interior Telephones

Standard for almost half a century. Made to give good service, look well and wear long. They have special advantages possessed by no other make. Our catalogs give full information and descriptions.



No. 52 A

Made in a wide variety of styles each suited for its particular requirement.

Write for Catalog 22 C and Full Details

Don't pass up this profit-opportunity. Ask us for full particulars of our proposition. You'll find it worth your while to investigate.

Connecticut Telephone & Electric Company, Inc.
Meriden, Conn., U. S. A.

What's in a name ?

"LE CARBONE"

(Made in France)

Carbon Brushes

Means:
- **Lowest yearly** brush **cost.**
- Increased car mileage.
- Practically no commutator wear.
- Armature room **expense reduced.**
- Perfect uniformity of effiiciency.

Le Carbone Brushes quality never varies!

Rougier Freres Inc.
63 Notre Dame, East
MONTREAL, P.Q.

Don't Let Hot Weather Catch You Unprepared

Our advertising is going to start people in your town thinking about electric fans the first hot day. Don't force them to go to your competitors because you are not ready with a stock of

One of the illustrations in our magazine advertising.

Robbins & Myers "STANDARD" Fans

We can give you prompt shipment and advertising assistance; cuts, booklets, window cards, etc., which should make this a bigger fan season than you have ever had before. And we guarantee you fans that will give the kind of reliable, economical service which will bring you business from the friends of every purchaser.

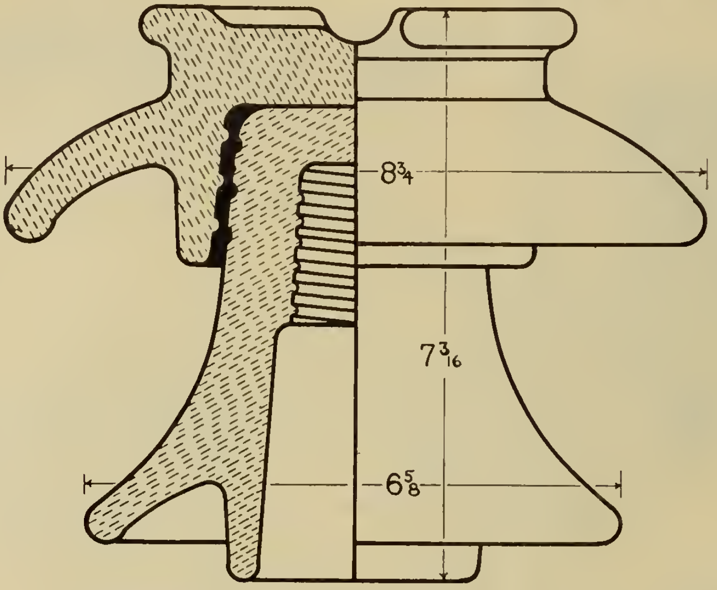
BY INVITATION MEMBER OF
NEW YORK U.S.A.

Drop us a line and get complete information on our agency proposition.

The Robbins & Myers Company
SPRINGFIELD, O.

The world's largest exclusive manufacturers of small motors, 1/60 to 15 horse power.

CANADIAN INSULATORS



Number	133
Line voltage	30,000
Test voltage	100,000
Rain test	65,000
Leakage distance	17¾-in.
Pin hole	1⅜-in.
Net weight	10½-lbs.
Packed weight	12-lbs.
No. per crate	6

The Canadian Porcelain Company, Limited

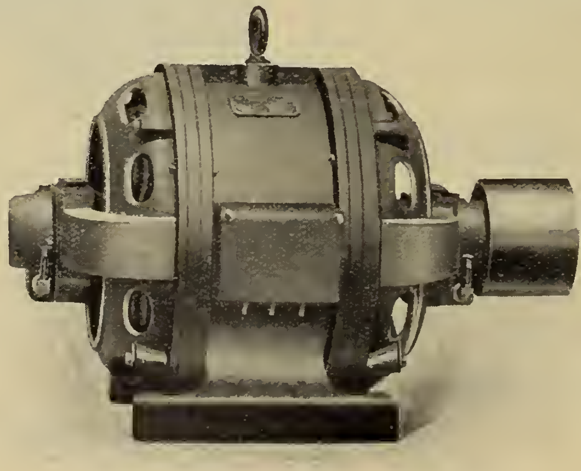
HAMILTON, - CANADA

UNION MOTORS

FOR

DURABILITY and EFFICIENCY

Ample Bearings



Sound Mechanical Design

Pattern H D Squirrel Cage Motor

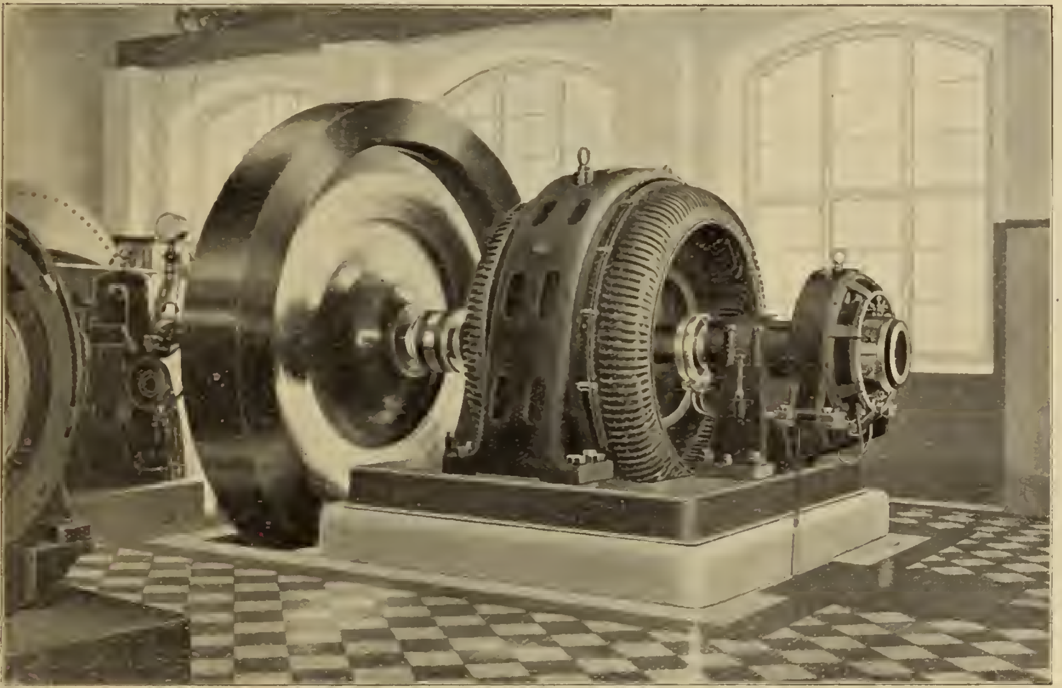
Canadian Union Electric Co., Limited
Head Office: 130 Wellington St., West, Toronto
Also at 9 St. Nicholas St., Montreal

Represented in Winnipeg by:
The Mainer Electric Co., Limited
61-63 Albert St.

Swedish Electrical Machinery

NOTED FOR

Efficiency and Workmanship



860 K.V.A. 3 phase, 60 cycle, 400 R.P.M., 11500 volt water wheel driven Generator with direct connected exciter.

We solicit your specifications for Electrical Equipment

BURNHAM ENGINEERING COMPANY
LIMITED

Canadian Dealers for
The Amalgamated Electric Company of Sweden

Head Office:
Traders Bank Building, Toronto
British Columbia Representatives:
Macdonald, Marpole, Co., Limited
VANCOUVER, B.C.

Montreal Representatives:
Rudel Belnap Machinery Co., Ltd.
Canadian Express Bldg.

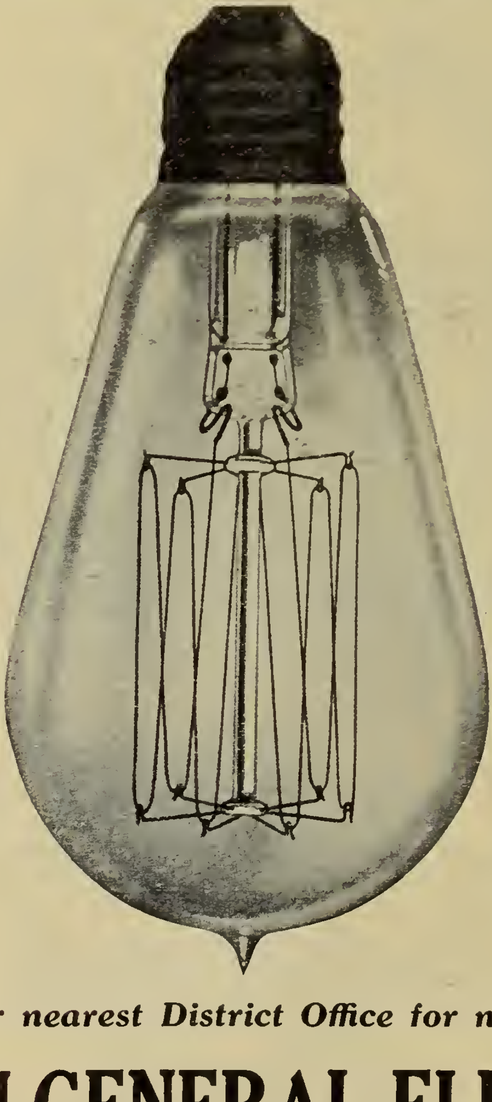
Incandescent Lamps

TO THE TRADE

Important Price Reductions become effective May 1, 1914, on all classes of C.G.E. Incandescent Lamps.

The Standard of Excellence.

Lamps for Every Class of Service.



Write our nearest District Office for new prices.

CANADIAN GENERAL ELECTRIC CO.

LIMITED

Manufacturers of Electrical Apparatus and Supplies
for Railway, Light and Power Purposes

Head Office: Toronto. District Sales Offices: Montreal, Halifax, Ottawa, Cobalt, Porcupine, Fort William, Winnipeg, Regina, Saskatoon, Calgary, Edmonton, Nelson, Vancouver, Victoria, Prince Rupert

Century

Single Phase Motors

are the enduring kind. They continue to give satisfactory results—their characteristics do not change.

1/4 to 40
H. P.

25 to
140 Cycles

Bulletin No. 201 describes them.

Century Electric Company
19th, Olive to Pine Sts., ST. LOUIS, Mo.

CANADIAN AGENTS
Jones & Moore Electric Co., Ltd.
294 Adelaide St. W., Toronto
Mainer Electric Co., Ltd.
Winnipeg and Edmonton
Rudel-Belnap Machy. Co., Ltd.
Canadian Express Bldg., Mont.
Rankin & Cherrill
547 Main St., Vancouver

Ⓣ Trumbull Ⓣ

Panels and Switches

Panel for Plug Fuses

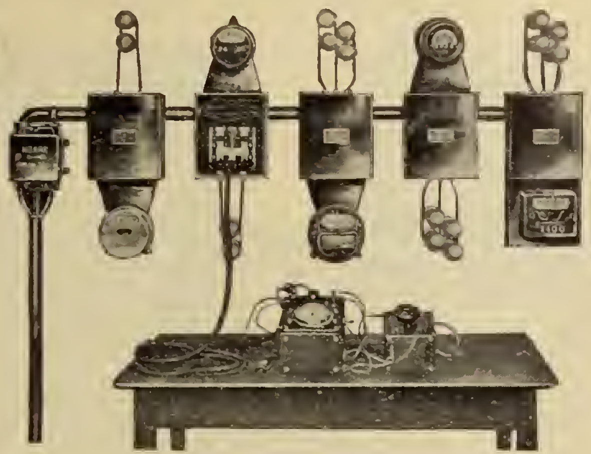
Snap Switch Panel

A complete line of panel boards, cabinets, knife switches, snap switches, cut-outs, rosettes and many other electrical supplies.

ASK YOUR JOBBER

SEND FOR CATALOGUE

The Trumbull Electric Mfg. Co.
Plainville, Conn., U.S.A.



“NOARK”

Service Meter
Protective Devices

are the latest and most improved method of simplifying your meter testing.

They prevent interrupted service and theft of current.

They are adaptable to all types of meters and form an important part of the “NOARK” System.

When installed singly or in bank, the entire service installation may be securely sealed as shown in above illustration.

Interchangeability of unit parts makes large stocks unnecessary.

“NOARK” Meter Protective Devices occupy a minimum of space.

A representative will show you a sample or our nearest branch will supply you with catalog No. 413 upon request.

**THE CANADIAN
H. W. JOHNS-MANVILLE CO.
Limited**

Manufacturers of Service, Subway and Transformer Boxes, Fuses, Line Material, Insulating Materials, Fibre Conduit, Fireproof Wood, Friction Tapes, Dry Batteries, Lighting Systems, etc.

J-P.Co. REG. IN U.S. NOARK PAT. OFF. FUSE

TORONTO
MONTREAL
WINNIPEG
VANCOUVER

J-P.Co. REG. IN U.S. NOARK PAT. OFF. FUSE

Member of the Society for Electrical Development, Inc.
“DO IT ELECTRICALLY”

EUREKA Vacuum Cleaner

This complete cleaner is something that many of your customers will buy upon demonstration. The Eureka is light and easily operated, it has tools for cleaning everything in a house and the cost is very reasonable. The motor is made specially for the purpose in our own factory and will last a life-time.

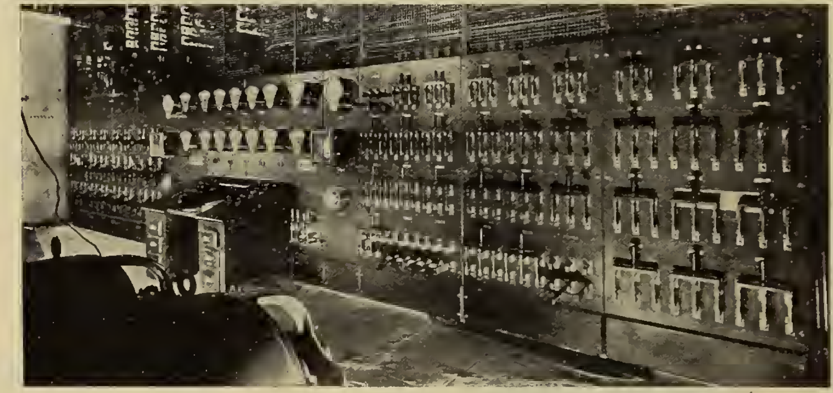
The Eureka has been on the market for over five years and generally conceded to be the best portable electric vacuum cleaner.

Write for literature and dealers' proposition.

ONWARD MFG. CO.
BERLIN, ONT.

Switchboards and Panels

Marked " Metropolitan " are the best that can be produced



FEEDER PANELS AND DESK BOARD, LORD & TAYLOR STORE, NEW YORK

We furnished the new Lord & Taylor Building with the remote control generator switchboards, having a desk board controlling the isolated generator panels. We also furnished the auto charging and dead front switchboards; power and light panel-boards, detachable mechanism, flush switches and receptacles.

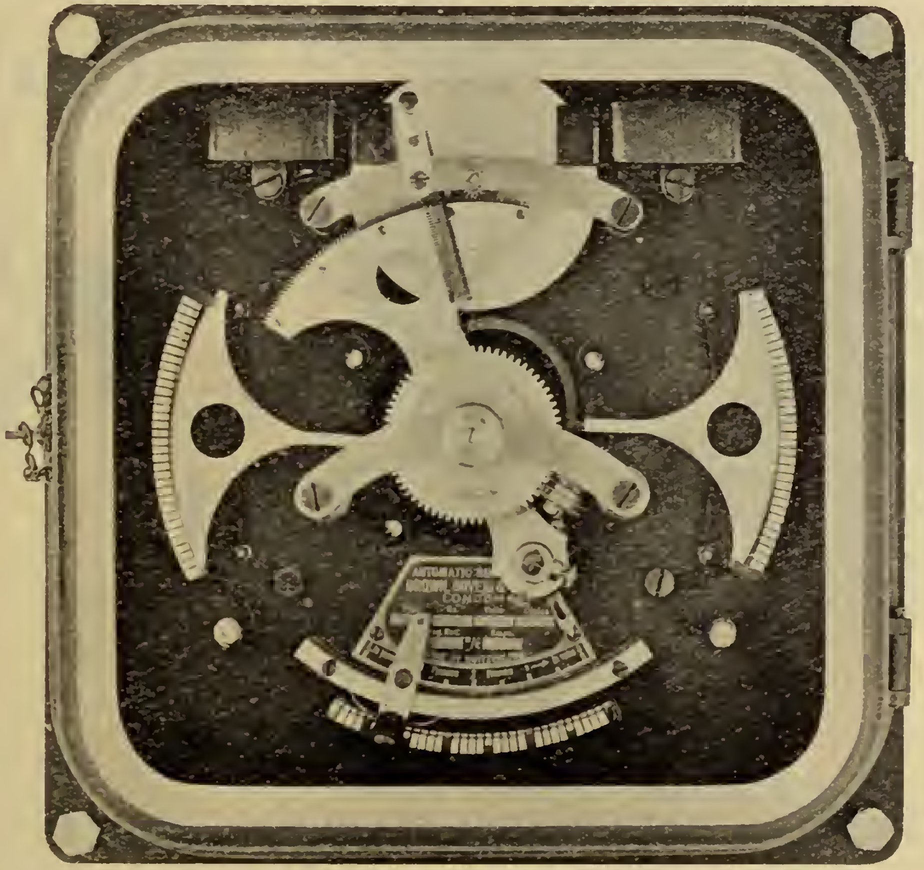
TRADE METROPOLITAN ELECTRIC MFG CO. MARK

CANADIAN AGENTS:

ECONOMY ELECTRIC CO.

Bank of Hamilton Building
Yonge and Gould Sts., TORONTO

BROWN BOVERI
AUTOMATIC VOLTAGE REGULATORS



Simple in Construction
Accurate in Regulation

Prompt in Action
Reliable in Service

Entirely without sliding or make and break contacts, and

Require No Attention

THOUSANDS ALREADY IN OPERATION

THE CANADIAN
CROCKER-WHEELER CO.
LIMITED
MANUFACTURERS AND ELECTRICAL ENGINEERS

Head Office and Works
ST. CATHARINES

District Offices
MONTREAL, TORONTO, VANCOUVER

Duncan Quality

Duncan Quality

Guaranteed by this
Trade Mark

TRADE DUNCAN MARK

Duncan Quality

Electrical Supplies

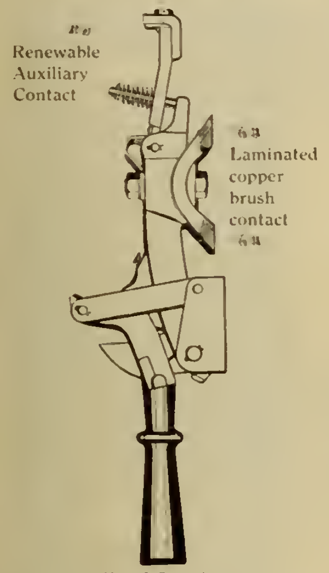
In this connection we suggest that you "keep an eye" on our ad. in this paper. We are bringing out a new line that sure will be a hummer.

We hope to be ready to make an announcement in our next ad. so be on the look out,—June 1st.

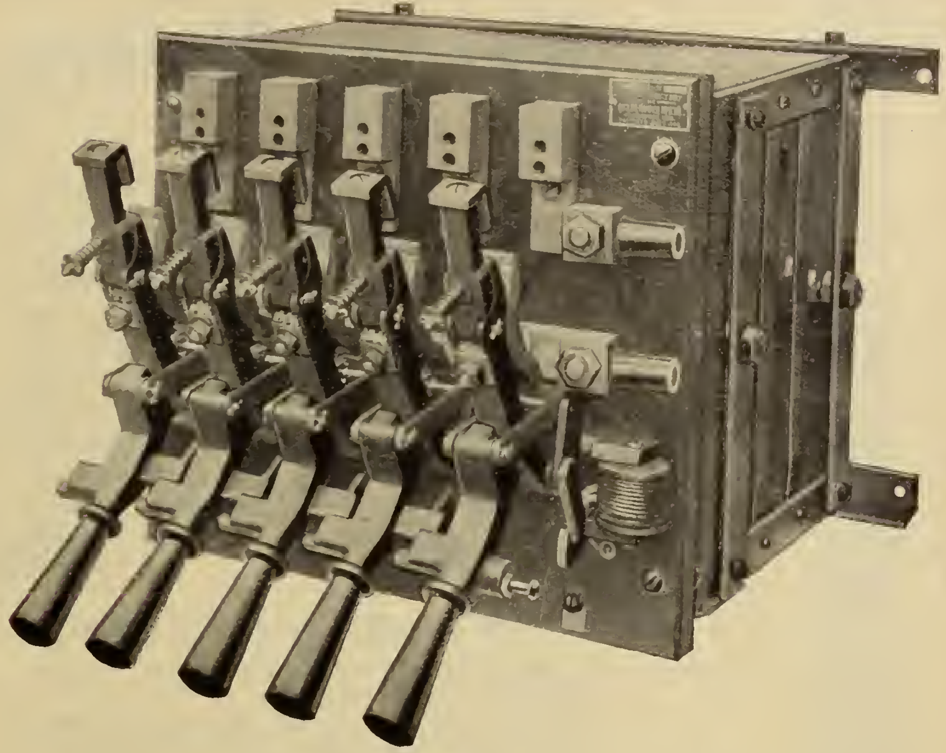
The Duncan Electrical Co.,
Limited
Montreal

Makers of "Duncan Quality" Electrical Supplies

CUTLER-HAMMER



Profile of Switch Lever



Cutler-Hammer Multiple Switch Type Motor Starters

are of exceptionally rugged construction and have sufficient resistance to cope with the heavy over-loads encountered when starting large motors or motors of medium size under severe conditions. When more than 5 seconds are required for acceleration the multiple switch starter is preferable.

The cutting out of each step of resistance is accomplished by a separate lever, the levers being so interlocked that it is impossible to close them except in the proper order. The auxiliary renewable contacts take the wear which is slight because of the snappy action of the switches in closing and opening.

For Severe Starting Service

The Cutler-Hammer Multiple Switch Type Starter insures proper starting of large motors and motors of medium size that are started under severe conditions.

With this type of starter the closing of the individual switches introduces a desirable time element, preventing the acceleration of the motor too hastily. The individual switches of

CUTLER-HAMMER
Multiple Switch Starters

can only be closed in their proper order, insuring proper cutting out of the resistance and proper acceleration. It is also impossible to burn out the resistance due to leaving part of the switches closed.

Five times as much current can be carried by the laminated brushes and hard rolled copper contacts of multiple switch starters than by sliding contacts.

THE CUTLER-HAMMER MFG. CO. MILWAUKEE

NEW YORK: 50 Church Street CHICAGO: Peoples Gas Bldg. PITTSBURG: Farmers' Bank Bldg. BOSTON: Columbian Life Bldg.
PHILADELPHIA: 1201 Chestnut Street CLEVELAND: Schofield Building CINCINNATI: Fourth Nat'l Bank Bldg.
PACIFIC COAST AGENT: H. B. Squires Co., 579 Howard St., SAN FRANCISCO, San Fernando Bldg., LOS ANGELES
and Morgan Building, PORTLAND, ORE.

Wagner Motors

Continuity

of service is a "characteristic" of alternating current motors not listed in catalogs nor ordinarily mentioned in specifications and not always appreciated by purchasers. That a motor deliver its rated power continuously and live up to its guarantees are often the sole considerations toward its selection. The discerning Canadian purchaser, however, often investigates such details as weight of the motor and its overload capacity. In such instances Wagner motors are usually selected because they are the most liberally designed of any competitive makes. By actual weight they will be found from

25% to 100% Heavier in Active Material

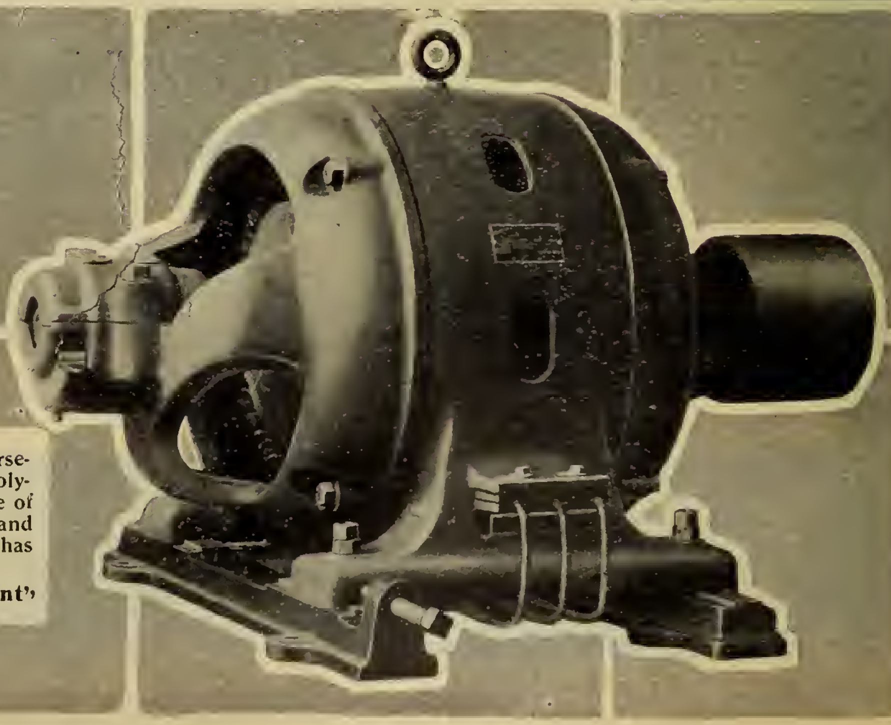
for a given rating than other motors. Frames, end-plates, bearings, etc., are especially rugged.

We are therefore prepared to supply you with Wagner single-phase and polyphase motors, which give you the quality that will long be remembered after the price is forgotten.

Northern Electric Company
LIMITED

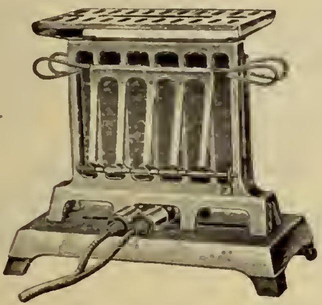
MONTREAL **WINNIPEG** **EDMONTON**
HALIFAX **REGINA** **VANCOUVER**
TORONTO **CALGARY** **VICTORIA**

61-2061



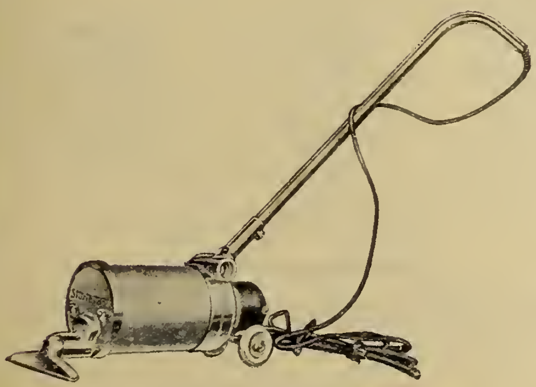
Wagner Thirty Horse-Power Self-Starting Polyphase Motor. Because of its simplicity of control and reliability this motor has been named
"The Public Servant"

61-0330



Profitable Lines to Push

—and Always Seasonable



Yes, household electrical appliances are profitable lines to handle. So profitable that it is well worth a dealer's while to feature them.

They are always seasonable, of course, but especially so at this time of the year, when busy housewives are thinking of the hot weather that is soon to come.

All of our houses stock the lines you want—Irons, Toasters, Grills, Coffee Percolators, Chafing Dishes, Water Heaters, Vacuum Cleaners, and the hosts of other articles that have been devised to lighten housekeeping.

Order now and be fully prepared to get after this profitable business. Order from us and get goods that are guaranteed to give satisfaction.

All of our houses carry complete stocks. Your order will receive immediate attention.

Northern Electric Company
LIMITED

MONTREAL
HALIFAX
TORONTO

WINNIPEG
REGINA
CALGARY

EDMONTON
VANCOUVER
VICTORIA

Tallman Fixtures
They're
Different

Tallman's
Reputation is in
the Goods.

Tallman Brass & Metal Co.
HAMILTON, ONT.

"AMERICAN"
Bituminized Fiber Conduit
For Underground Construction

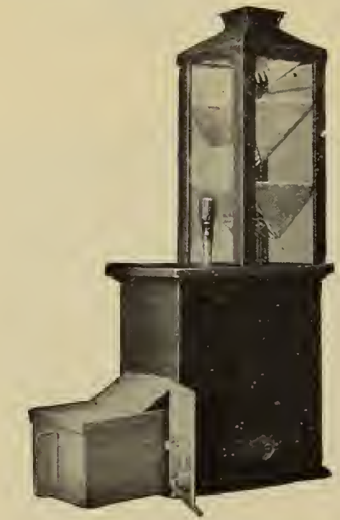
7 Foot Lengths. 3/8 Inch Walls. 5/8 Inch Joints.
Absorption, 100 Hrs., 3/4 of 1%. Puncture Test 50,000 V
Electrolysis-proof—Water-proof—Gas-proof

Comparison of above figure with other type of Fiber Conduit will show the superiority of our product.

Interesting and Valuable Booklet "Underground Conduit Construction" free on request. Send for it.

American Conduit Co.
East Chicago, Ind., U. S. A. **140 Nassau St., N. Y. City**
Distributors for Canada:
Northern Electric Company
LIMITED
Montreal, Halifax, Toronto, Winnipeg, Regina,
Calgary, Edmonton, Vancouver, Victoria

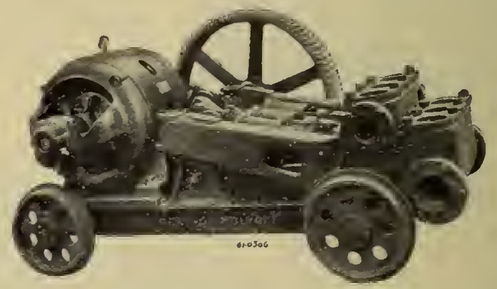
SAFETY FIRST
The Important Factor in Fare Collection



Satisfaction Guaranteed
Write for Catalog

Cleveland Fare Box Co.
5310 St. Clair Ave., Cleveland, Ohio

WAGNER SINGLE PHASE **MOTORS**



Wagner 15 horse-power Single-Phase Motor driving horizontal triplex single acting truck mine pump.

Self-starting under full load with no other device than a double pole switch.

Rugged and reliable. Probably not so low in first cost as some others but with them first cost is last cost. They do not add to their cost by expensive shutdowns of your plant.

¼ to 60 H.P. for all commercial frequencies and voltages.

Bulletin 10113

Wagner Electric Manufacturing Company
of Canada Limited-Montreal
27 Guardian Bldg., Montreal 1222 Traders' Bank Bldg., Toronto
Member of the Society for Electrical Development—
Do it Electrically.

Use this sales plan

We finance it — you back it up with personal calls

This is a campaign for window lighting and wiring business, using X-Ray Reflectors. We launched it last month. 250 Contractors, central stations etc., have taken it up so far. Sales have been most gratifying.

This is the plan -- it costs you nothing

You carefully compile a list of names and addresses of the merchants in your locality who need better window lighting. Mail it to us. At our expense, we mail each merchant the three folders at intervals of two days. Each folder has a return card. **This card bears your name** and when the merchant mails it you get the inquiry direct.

You wait till the three folders have reached the merchant and then call personally on each. Try and get permission to make a demonstration of X-Ray window lighting in his windows, in a dark room, or in the cellar if need be. Once the merchant sees the "search light" effect he grasps the idea and the sale is easily made.

To assist you, we offer to ship you four Scoop Reflectors and bill them to you **four months from date** with permission to return them if the plan fails.

As you're reading this, make out a list of 25 or 50 names. Give this plan a trial.

Now read about the Results it gets

This is an extract from a letter received from a South Carolina contractor:-

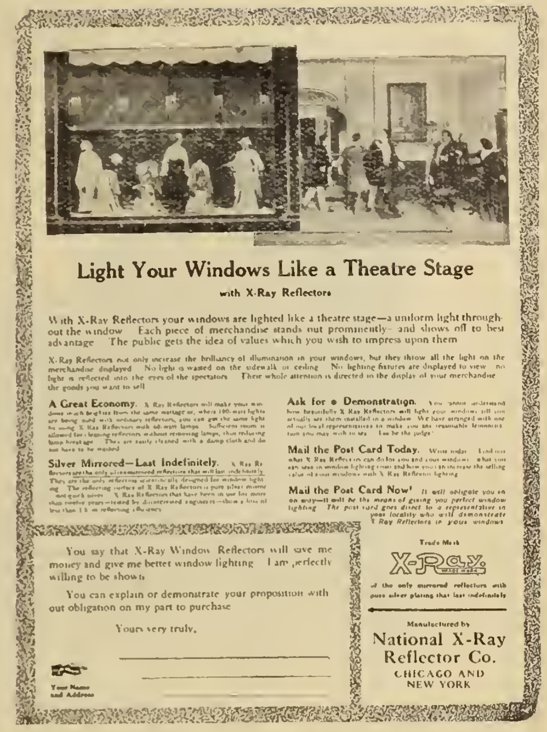
> "We have received the sample reflectors and have made several demonstrations. In nearly every case where we demonstrated these reflectors we got an order, and in the cases where we did not get an order we still have good prospects."

Here's one from LaCrosse:—

> "The circulars you sent out have had effect already," writes a LaCrosse, Wis., contractor, "as the Helfach Jewelry Store called us up this morning and we are going to install the reflectors in their window this afternoon."

> What is being done in South Carolina and Wisconsin can ALSO be done in California, Maine and Tennessee,—by YOU.

You can't get business any easier. Send the list in right now, before you forget it.



Light Your Windows Like a Theatre Stage

with X-Ray Reflectors

With X-Ray Reflectors your windows are lighted like a theatre stage—a uniform light throughout the window. Each piece of merchandise stands out prominently and shows off to best advantage. The public gets the idea of values which you wish to impress upon them.

X-Ray Reflectors not only increase the brilliancy of illumination in your windows, but they throw all the light on the merchandise displayed. No light is wasted on the sidewalk or ceiling. No lighting fixtures are displayed to view; no light is reflected into the eyes of the spectators. Their whole attention is directed to the display of your merchandise the goods you want to sell.

A Great Economy.

Silver Mirrored—Last Indefinitely.

Ask for a Demonstration.

Mail the Post Card Today.

Mail the Post Card Now! *It will obligate you in no way—it will be the means of giving you perfect window lighting. The post card goes direct to a representative in your locality who will demonstrate X-Ray Reflectors in your windows.*

You say that X-Ray Window Reflectors will save me money and give me better window lighting. I am perfectly willing to be shown.

You can explain or demonstrate your proposition without obligation on my part to purchase.

Yours very truly,

Your Name and Address

Trade Mark

X-Ray

the only mirrored reflectors with pure silver plating that last indefinitely

Manufactured by
National X-Ray Reflector Co.
CHICAGO AND
NEW YORK

National X-Ray Reflector Co.

CHICAGO
225 W. Jackson Blvd.

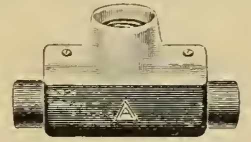
NEW YORK
6 East 39th St.

"UNILETS"

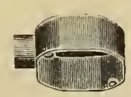
are drawn from steel and possess many merits which are an absolute necessity for up-to-date conduit work. For durability, neatness, space for making wire connections, "Unilets" meet all requirements. "UNILETS" are mechanically right. The conduit is steel, why not the fitting? Try them on your next job. A copy of our new catalogue should be before you. You cannot afford to be without it. Write us at once for your copy.

Cat. No. 9001—Rectangular Unilet.

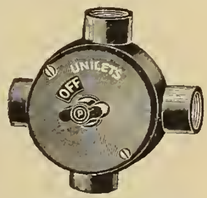
Cat. No. 9002—Rectangular Unilet.



Type No. 2—Rectangular Unilet. Cat. No. 9002 with No. 7650 Receptacle.

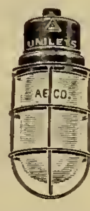


Type No. 1 Octagon Unilet. Cat. No. 7501.

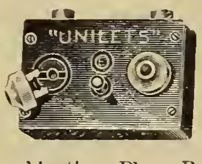


Type No. 4— Round Unilet with enclosed Snap Switch.

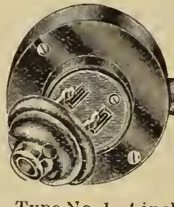
Cat. No. 7322—Shade Holder



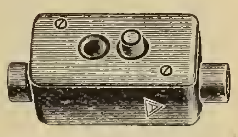
Cat. No. 6906 Vapor-Proof Unilet.



Combination Plug Receptacle and Push Button Switch Unilet—Hubbell Plug Receptacle and Arrow E Push Button Switch Attached.



Type No. 1—4-inch Round Unilet with Two-phase Receptacle Attached.



Type No. 2 — Switch Unilet. Cat. No. 6501, with Push Button Switch Attached.

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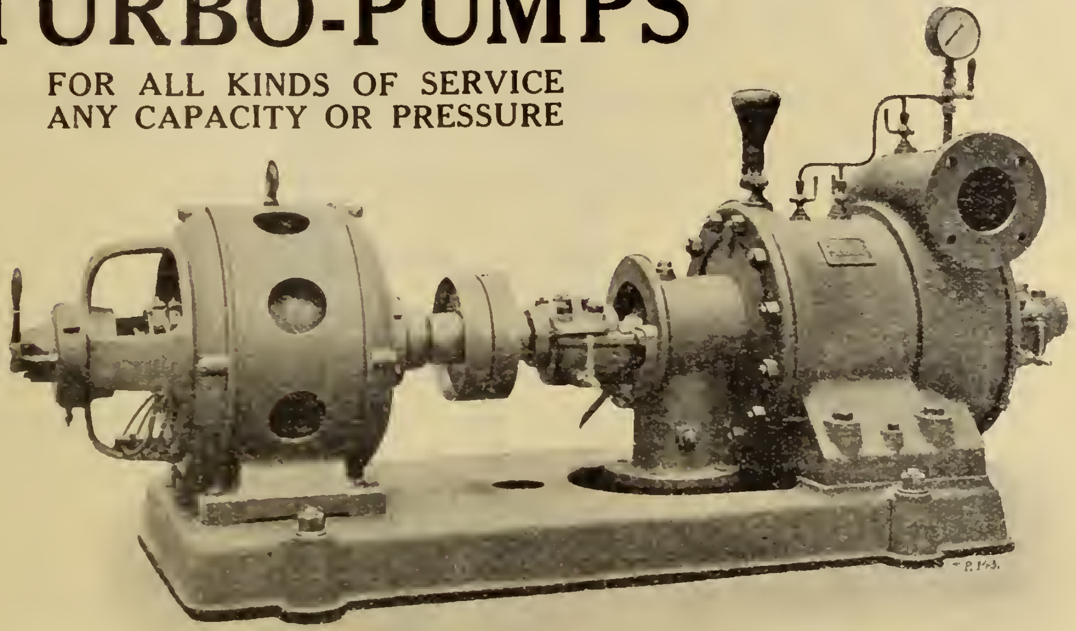

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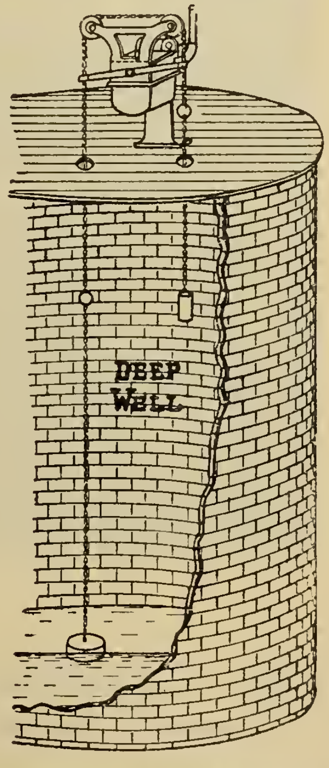

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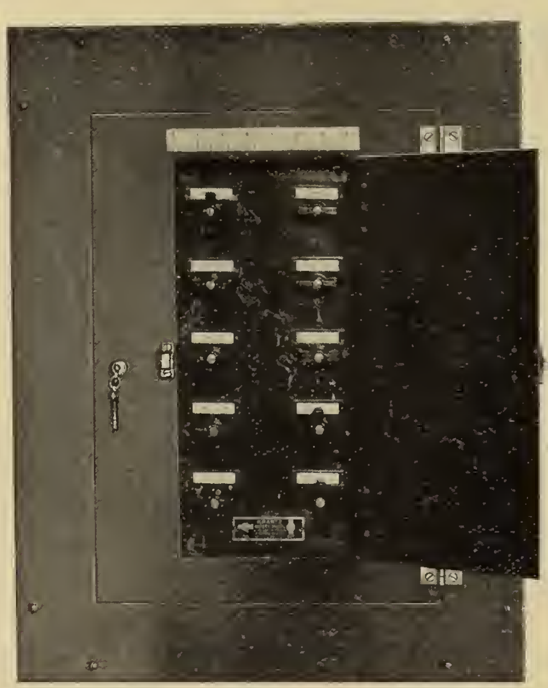

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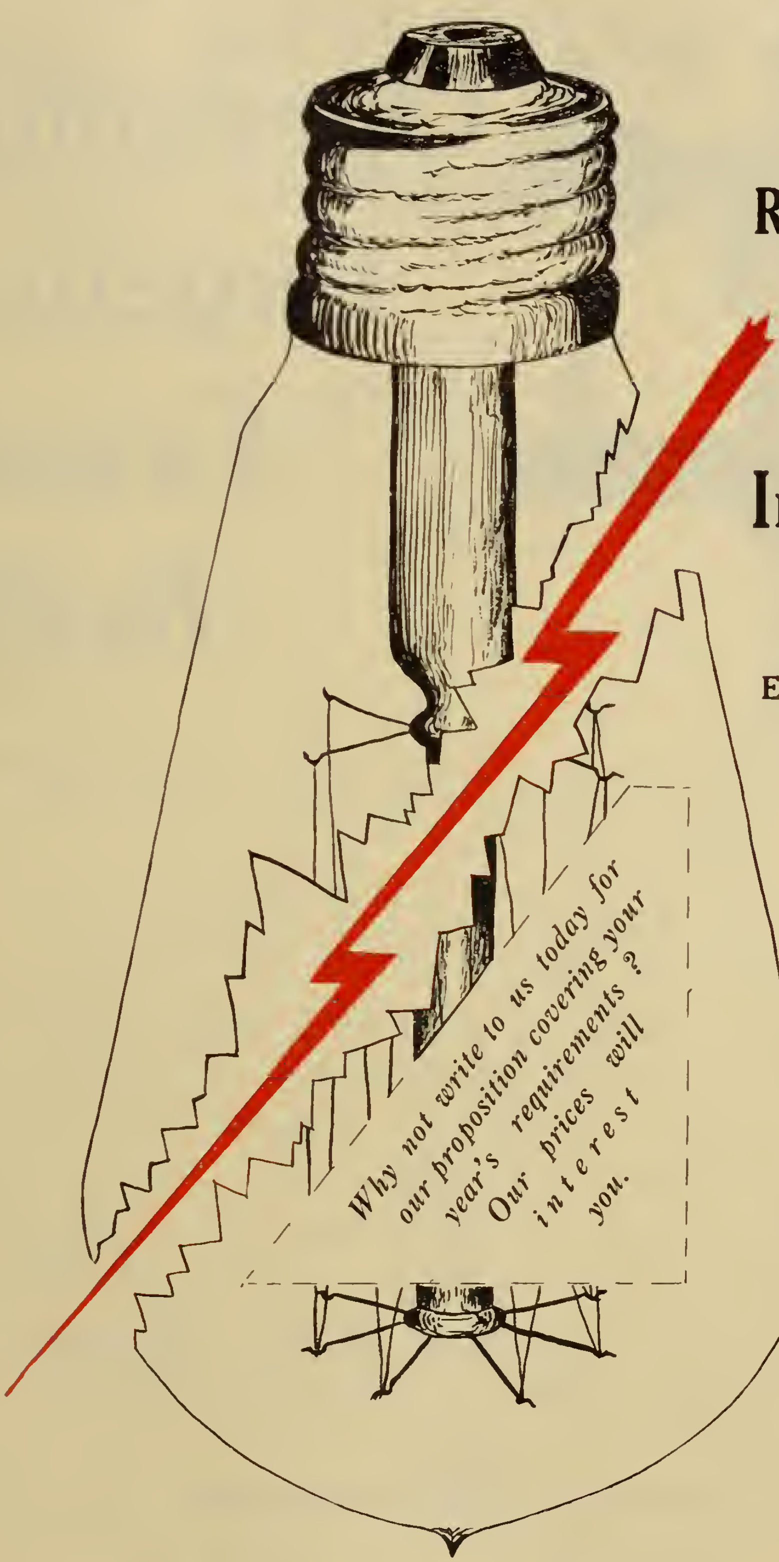

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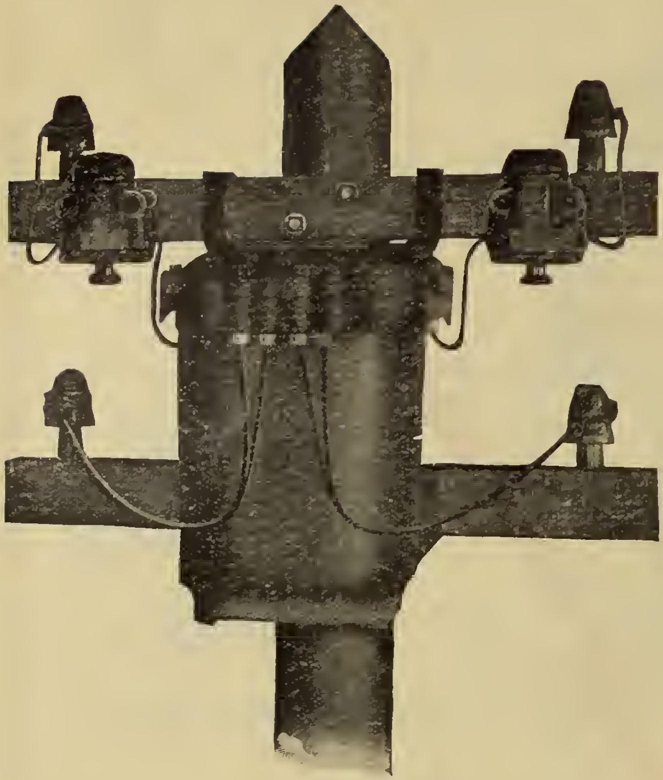

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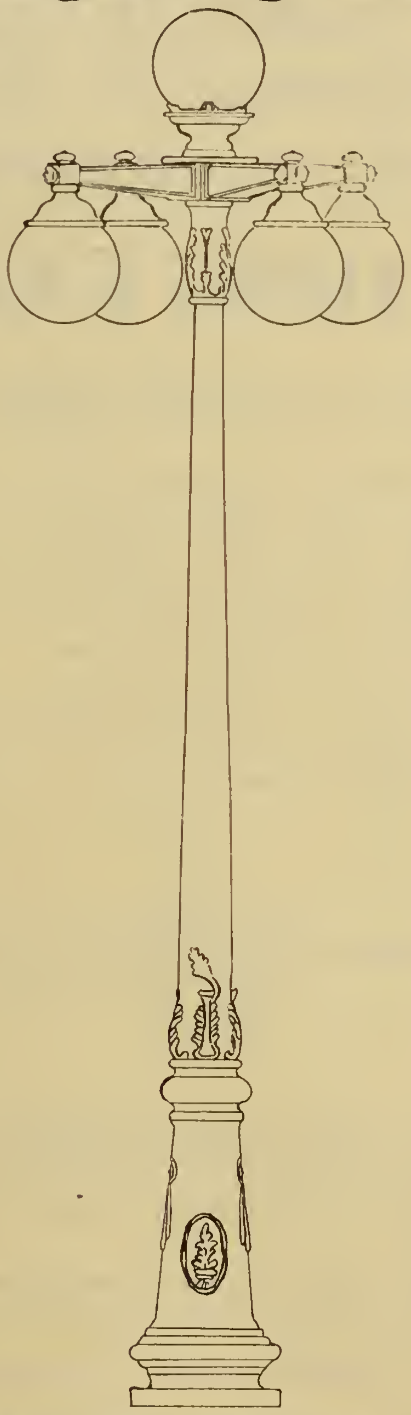

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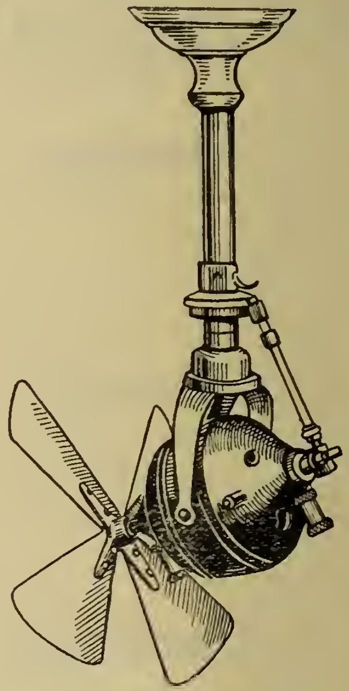

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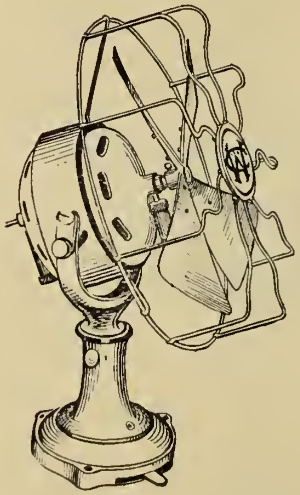

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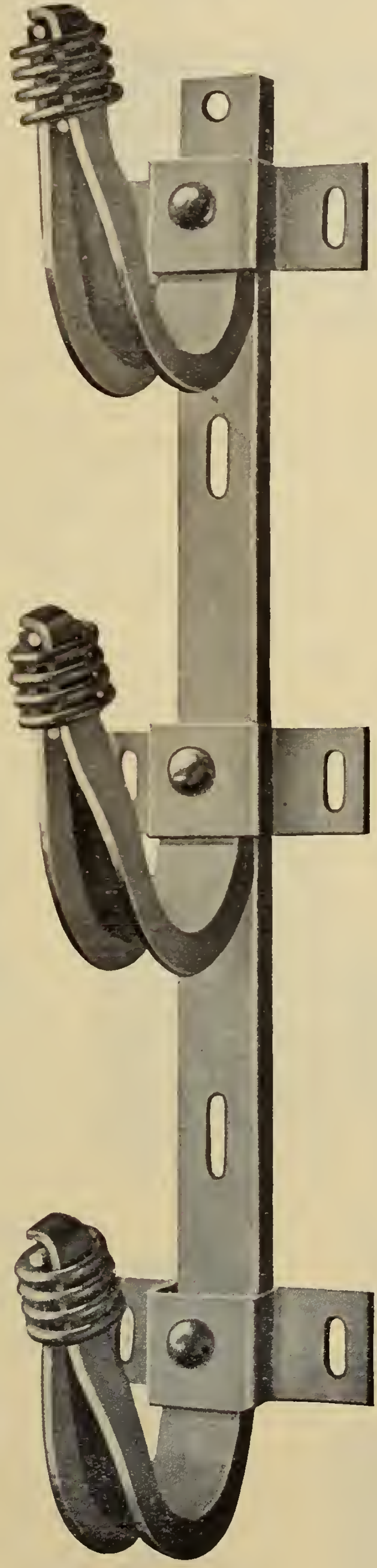

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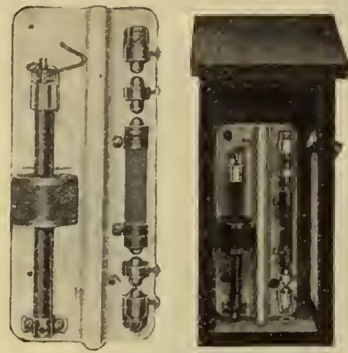

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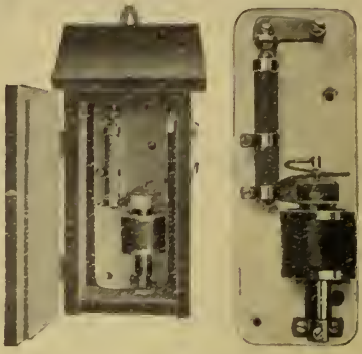

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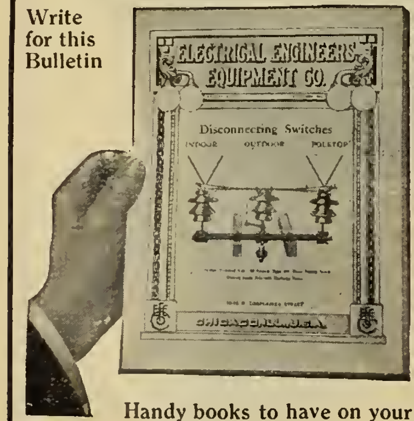

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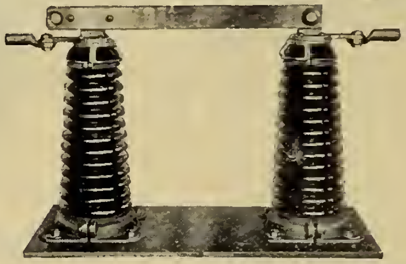

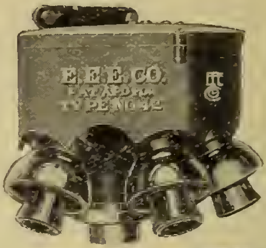

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Vol. 23 Toronto, May 1, 1914 No. 9

Capitalizing Improvidence

No act of recent years has started more discussion or created more intense opposition than the Workman's Compensation Act which has been introduced and is apparently about to be passed by the local Ontario legislature.

It will be remembered that some time ago Sir W. R. Meredith, Chief Justice of Canada, was appointed a one-man commission to prepare an act which would provide for the compensation of workmen for injuries contracted in the course of their employment.

The bill just introduced shows that an infinite amount of work has been done on the subject and that nearly every contingency has been considered. Provision is made for the appointment of a commission of three to have charge of the administration of the act.

That the bill has failed to win the approval of a very large percentage of the interested parties is only a proof that the subject is an exceedingly difficult one to handle. We understand that it is recognized both by the author of the bill and by the government that it is not likely to be workable in its present form. Wide powers are given the commission, however, and it is hoped that with this as a foundation something more workable and considerably more equitable can be evolved in the course of two or three years.

The bill appears to have shouldered an altogether too heavy load on the employer. He is made responsible for accidents over which he has no control whatever, and to an extent that may easily be the means of crippling many a business concern. Compensation payments as high as 55 per cent. of an employee's salary would be payable under certain conditions, which means that, as the salary limit is placed at $2,000, an employer may be made responsible for the yearly payment of $1,100 during the life of an incapacitated employee. Under such circumstances, it can readily be imagined that an accident or series of accidents out of the ordinary may be the means of ruining many an employer.

While there are many other points at which the bill is open to criticism, the basic weakness lies in the fact that the workman does not assume any part of the responsibility either for the accident which disables him or for the after payments. Thrift, one of the most important, if not the most important, characteristic of a good citizen, is not only not encouraged but is actually discouraged by requiring no part of the compensation fund to be contributed by the employee. The natural and certain tendency will be to make that class of workmen which is at present improvident, still more so; which is at present careless, still more so; which is at present inclined to the socialistic opinion that the world owes them a living, still more so. The bill in its present form capitalizes improvidence, carelessness and irresponsibility. While all will agree that a workman's compensation scheme, properly contributed to and properly controlled, is much to be desired, it seems very certain that the bill in its present form is quite unsatisfactory and unworkable.

Stand-by Steam Plants

The question of stand-by steam electric plants is occupying much attention at different points of Canada at the present time, and especially in sections of Ontario served by Niagara power. Apparently it is largely a matter of how much we value continuity of service and how much we are willing to pay for it. It is very doubtful, however, if the general public stands to reap any very great benefit from an expenditure of large sums of money on stand-by plants. True, it may be necessary to walk home once or twice a year or very occasionally to requisition the candle or coal oil lamp, but aside from a limited inconvenience it is not easy to see where the average user of electricity is financially interested. With the manufacturer and the storekeeper the case is different and, especially with the former, financial loss may be very considerable. However, trouble may happen only once a year or once in two years. For such a contingency the expenditure of hundreds of thousands of dollars which are lying worse than unproductive all the rest of the year seems a last resort.

Possibly the cry for stand-by plants has been a little over done. It certainly means an increase in rates for every class of customer served and it is very doubtful, indeed, if the carrying charges on such a plant would not much more than compensate for the losses sustained by the customers in any one year. In the advanced stage of transmission engineering as we have it to-day the chances of interruption are being gradually narrowed in by elimination, one after another, of the weakest points in design. Protective apparatus, more perfect insulators, duplication of line and all the other expedients would appear almost to make any further insurance unnecessary.

A noticeable feature of the stand-by plant as it exists in Canada is that it is found practically only under conditions of keen competition. In such cases a break in the service of either of the competing systems has been utilized by their opponents to get new business, and delays which in the ordinary way would have meant nothing more that a few minutes pleasant gossip among the temporarily unemployed have been magnified much beyond their actual significance. Under the lash of competition and the taunts of inferior service from opponents the expensive stand-by plant has been resorted to. We believe that every possible effort should be made to perfect the hydro-electric system in any particular locality and that only as a last resort and under very special conditions is it likely to be found that an expensive standby plant is in the best financial interest of the majority of the consumers.

An article of considerable value on this subject was read at the regular monthly meeting of the Toronto section of the A.I.E.E. by Mr. C. G. Spencer, mechanical engineer of the Toronto Power Company. Mr. Spencer is one of those who take it for granted that a standby plant is a necessity under such conditions as exist in Toronto. His paper, however, is of unusual interest as it treats in considerable detail of the necessary characteristics of a stand-by steam plant as compared with a steam plant designed to operate continuously. Mr. Spencer points out that these two types of plant differ in many ways and to such an extent that a unit specially constructed for either purpose cannot be efficiently used for the other. This is rather in opposition to the argument usually advanced that a steam unit can be used advantageously both to take care of emergency conditions and at a certain time of the day to take care of the peak load. In Toronto, we understand, the stand-by is utilized only for the one purpose for which it was installed, namely, emergencies. Mr. Spencer's paper appears in part on other pages of this issue. The extracts quoted deal particularly with the general design and characteristics of any stand-by plant. The remainder of the paper dealt chiefly with a review of the improvements and extensions that have been made to the Toronto stand-by plant of the company with which Mr. Spencer is associated.

Conservation of Coal in Canada

Canada's dependence on the United States for its supply of anthracite coal is a point strikingly indicated in the report just issued by the Commission of Conservation, on the "Conservation of Coal in Canada." Practically all of the most populous portion of Canada lying between Montreal, Que., and Moose Jaw, Sask., relies solely on the United States for its supply of anthracite coal. Further, there are indications that the United States may, in the comparatively near future prohibit the export of anthracite, and, as the only anthracite deposits thus far discovered in Canada, are confined to the area near Banff, Alta., it is of great importance that suitable substitutes be found as soon as possible.

Such a situation makes it clear that Canada should carefully husband her coal resources and, so far as possible, check all wasteful methods of mining and handling coal. With this end in view, the report suggests greatly needed changes in the form of coal-mine leases, the provisions of which should be carefully enforced by a competent engineering authority. This would go far towards preventing the careless practices followed at present in many coal mines. In addition to this, it is urged that the government should carry on investigations with a view to determining the suitability of slack and low-grade coals for use in gas producers for generating power, and their adaptability for the manufacture of briquettes for domestic use. By utilizing these inferior products in this way, not only would there be less waste, but the value of the public coal lands would be considerably increased.

Again, it is pointed out that central power stations situated in the vicinity of many of the lignite fields of Western Canada, could develop electric power for transmission to neighbouring manufacturing centres. This would mean a great saving, especially in the case of lignites that will not stand shipping to any considerable distance.

The experience of Great Britain, the United States and other countries in the manufacture of coal briquettes is given in some detail, and the methods adapted to conditions in Canada are indicated.

Comparisons are made between the bee-hive ovens and the by-product ovens for the coking of coal and the economies effected by the latter over the former are clearly presented.

In addition, short descriptions are given of the principal coal mines in Canada, as well as of the by-product coke oven plant of the Algoma Steel Company at Sault Ste. Marie, Ont. The report is well illustrated by means of maps, diagrammatic sketches and half-tone engravings, and should prove of great value, not only to those directly engaged in coal mining, but to all who are interested in the economic welfare of the Dominion.

Shawinigan Plant Completed

The Shawinigan Water and Power Company have now completed the five units in No. 2 power house. The third unit was started on September 1st last, the fourth on April 25 of this year, and the fifth will be in operation on May 15th next. Each unit has a capacity of 18,000 horse-power, or a total of 90,000 h.p., which can be raised to 100,000 h.p. in case of emergency. As No. 1 power house has a capacity of 55,500 h.p., the entire plant has a total of 145,000 electrical h.p.

The No. 2 power station is in two divisions, each consisting of two units, with the third unit in the centre, which is considered as a spare. The width of the building is 115 feet, length 180 feet, and the height from the bottom of foundation to roof is 112 feet. It is built entirely of reinforced concrete, brick and steel. The walls inside are faced with pressed buff brick, and up from the floor to about 10 feet with glazed enamelled brick.

All hydraulic machinery is separated from the electrical machinery by a reinforced concrete wall 16 feet high. The main turbines are of twin spiral case type. The rating of the turbine is 18,500 horse power, with an effective head of 145 feet. Each turbine is provided with an automatic governor and governor engine and with a relief valve. Each turbine is directly coupled to a three-phase, 15,000 kw. generator, and each generator is connected directly to a three-phase, 15,000 kw. transformer, which raises the tension from 6,600 volts to 100,000 volts.

The transformers can be connected on the high tension side to two bus-bar systems. These bus-bar systems are provided with sectionalizing switches, so that each unit with its transformer can be connected directly to its 100,000 volt transmission line. Each transformer is installed in the power house, and located on the basement floor, 11 feet below the main floor, on the tail-race side. These transformers are about 23 feet by 9 feet with a height of about 18 feet.

In the development for the second plant the canal was enlarged at the end to a forebay close by the new bulkhead constructed at an angle of about 30 deg., with the old bulkhead and adjoining it. The bulkhead is built of reinforced concrete and steel and provision is made for five 14-foot penstocks and one four-foot penstock to the exciter. The width of the bulkhead at the bottom is 60 feet. The height from the rock to the operating floor is 40 feet, and the length of the structure 225 feet. Each unit is complete in itself and independent, straight through from the bulkhead, penstock, turbines, generator, transformer, transmission line and step-down transformer at Montreal.

The penstocks which connect the bulkhead to the power house, located on the lower level, are 14 feet in diameter and about 600 feet long. Inside the power house, immediately in front of each water turbine and below the main floor, each penstock ends in two branches, forming the connections to the two cases of the double spiral turbines.

The thirty-seventh convention of the National Electric Light Association will be held in Philadelphia June 1-5, 1914.

International Conference on City Planning

During the last five years national conferences on city planning have been held annually in various cities of the United States, and have aroused such widespread interest that many American communities are now anxious to have the Conference held in their city and are willing to contribute the funds for that purpose. The city of Toronto, therefore, is to be congratulated on being the first place on this side of the International boundary to entertain the Conference, which this year will become international in scope and character. The financial difficulties have been overcome by a generous grant from the Dominion Government, which has appointed the Commission of Conservation to act as hosts. The Ontario Government and the city of Toronto are also contributing. The question of city planning is thus recognized to be of national, provincial and municipal concern, and Field-Marshal H. R. H. the Duke of Connaught, the Governor-General, has graciously consented to open the Conference and to give an address.

The substantial assistance given by the Dominion Government is evidence that the town-dweller, equally with the agriculturist, is receiving attention, and that no only the Federal capital, but all our Canadian cities are receiving from the Federal authorities such advice and assistance as the Congress will afford them. Invitations have been sent to all cities and towns in the Dominion, requesting them to send delegations to the Conference and it is hoped that many will take advantage of the opportunity. Money could be spent to no greater advantage than in giving some of our city councillors the opportunity to come into touch with experts in civic problems from all over the continent. The aldermen will carry home ideas that, put into practice, will save their townspeople millions of dollars, besides acquiring a new sense of the responsibilities of their office and higher ideals of civic administration.

The scope of the Conference may be gauged by a glance at some of the topics which will form the main themes of discussion. Among these may be cited: The Relative Importance of City Planning as Compared with all other Functions of City Government, by Andrew Wright Crawford, editor of the city-planning section of the "Public Ledger;" Provision for Future Rapid Transit, by J. V. Davies, consulting engineer for the Brooklyn Rapid Transit Company; Rapid Transit and the Auto Bus, by John A. McCollum, assistant engineer, Board of Estimate and Apportionment, New York City; Protecting Residential Districts, by Lawrence Veiller, secretary and director of the National Housing Association, New York City; Toronto's Water Front Development, by R. S. Gourlay, of the Toronto Harbour Board; A Consideration of the Principles and Procedure of a Canadian Town-Planning Act, a draft of which is now being prepared by a special committee apopinted by the Commission of Conservation; and Recreation Facilities in the City Plan, by Henry V. Hubbard, professor of landscape architecture in Harvard University.

Additional interesting features will be a tour of the city and harbour of Toronto, luncheon topics, and an open session for the discussion of subjects to be submitted by members of the Conference.

Hamilton Pumping Station

The high level pumping station on Ferguson Avenue, Hamilton, is now equipped with electrically driven turbine pumps. When hydro-electric power appeared on the scene it was decided to replace the old steam plant by electric units. This station supplies water to two separate levels, making it necessary to install two different sets of pumps and each set was duplicated in order to make it sure that at least one set would always be available.

The two low pumps are special No. IV. two stage Mather and Platt patent high turbine pumps, each capable of delivering one million Imperial gallons per 24 hours against a total head from all causes of 131 feet. These pumps are direct-connected by flexible belt laced couplings to 40 kv.a. Canadian General Electric synchronous motors with direct connected exciters. On test at the factory, a pump efficiency of 79 per cent. was obtained which, we understand, constitutes a record for this size of pump.

The pumps for the higher level are two standard No. V. four stage Mather and Platt patent high lift turbine pumps, each capable of delivering one million Imperial gallons per 24 hours against a total head from all causes of 326 feet. These pumps were connected by flexible belt laced couplings to two 100 kv.a. Canadian General Electric synchronous motors with two direct connected exciters. They were guaranteed to have 70 per cent. efficiency but actually gave 72 per cent. on official test.

The switchboard also equipped by the C. G. E. Company, consists of five natural black slate panels of the central station type, equipped with horizontal edgewise instruments and K-3 oil switches, each of which is tripped automatically through an inverse time limit overload relay. One panel is provided for the control of each synchronous motor and the centre panel controls duplicate incoming lines. A voltmeter is mounted on a swinging bracket at the end of the board and is arranged to read bus voltage on all three phases.

The line panel contains one oil switch, for each of the two lines and a single set of meters consisting of:—3 ammeters; 1 polyphase indicating wattmeter; 1 polyphase curve drawing wattmeter; 1 polyphase watthour meter.

Each synchronous motor panel is equipped as follows:—1 polyphase indicating wattmeter; 1 power factor indicator; 1 field ammeter; 1 rheostat mechanism; 1 D. P. D. T. field switch connected so as to excite the motor field either from a direct connected exciter or from a common exciter bus; 1 overload relay; 1 automatic oil switch; 1 starting compensator; 2 current transformers.

Starting arrangements for the motors are worked out in an unusual but very convenient way. Standard compensators are mounted on the wall, back of the switchboard, and are connected by bell cranks and operating rods to operating handles on the front of the panels, this mechanism being almost identical with the standard remote control oil switch mechanism. Ample room has been allowed for the switchboard equipment.

The "Cedars" High Voltage Switchboard

The General Electric Company, Schenectady, have obtained the contract for the switchboard for the 100,000 h.p. hydro-electric development of the Cedars Rapids Manufacturing and Power Company. This development is situated on the St. Lawrence river, about 35 miles above Montreal. The present switchboard installation is to be for the control of nine 10,000 h.p. units. The plant consists of a power house and a step-up transformer house, which are constructed separately, the transformer house being about 800 feet from the power house. The power house as at present laid out will have, as stated above, nine 10,000 h.p. turbines, each connected to a vertical water wheel type generator having a capacity of 7,500 kw. at 6,600 volts. There will also be three 1,500 h.p. exciter turbines each connected to a 1,250 kv.a. vertical water wheel type generator. These exciter generators will operate at 2,300 volts and will supply three-phase energy for driving individual motor generator exciter sets for exciting the main generators. The direct current generators of these motor generator sets will each be operated in connection with a Tirrill regulator.

In the transformer house will be located the step-up transformers and a double set of low tension bus bars. Each 7,500 kw. generator in the power house feeds through directly to these bus bars in the transformer house. On each of these generator circuits will be one oil switch in the power house and two oil switches in the transformer house, one for each low tension bus bar.

The switchboard installation is divided into three sections:—first, the main control board for the 10,000 h.p. units in the power house; second, a vertical switchboard, which controls the 2,300 volt exciter system in the power house; and third, a control board and instrument panels for the control of the transformer circuits in the transformer house. The power output of the development will be measured on these transformer instrument panels.

The control board for the main units in the power house consists of nine sections, each controlling one main unit. Every section is made up of two portions—a control desk and an instrument panel. The equipment of the latter consists of the instruments for measuring the power output of the unit and a signal device for receiving and delivering signals from and to the generator room. The following is the detailed equipment of these generator instrument panels: one watt hour meter, one indicating a.c. ammeter, one indicating a.c. volt meter, one indicating watt meter, one indicating power factor meter, one d.c. volt meter, and one d.c. ammeter, the two latter being for the 150 kw. exciter. On the control desk are situated the controllers for operating the oil switches on the generator circuits; also the controllers for operating the field switches and field rheostats for the main generators. The excitation for the main generators is obtained from individual 150 kw. motor-generator sets, which are driven by 225 h.p. induction motors, the latter receiving their power from a 2,300 volt, 60-cycle, 3-phase alternating current circuit. On the control desk are also situated the necessary controllers for the field rheostats of these motor generator sets. This main control board will be furnished with two synchroscopes mounted on a swinging bracket for synchronising the generators. The synchroscopes are so arranged that in case one should be out of order the other may be used for synchronising any of the generators.

The 2,300 volt switchboard is used for controlling the excitation system in the power house. This is a 2,300 volt, 60-cycle, 3-phase system, energy for which is supplied from the three 1,250 kv.a., 60-cycle, 3-phase water wheel driven generators. These latter supply the necessary power for driving the motor-generator sets used for exciting the main generators. This 2,300 volt power is also used for the various auxiliary circuits throughout the power house, such as the pump motors, etc.

The 2,300 volt switchboard is made up of the following panels: three 1,250 kv.a. generator panels; ten 225 h.p. induction motor panels; one 2 circuit feeder panel; two 1 circuit feeder panels; one transformer panel. On the 1,250 kv.a. generator panels are mounted the necessary instruments for measuring the power output of the generators, the controllers for the generator oil switches, governor engine motor controllers, field rheostat controllers, field switch controllers, and the signal devices for receiving and sending signals from and to the generator room. The 10-225 h.p. induction motor panels are for the control of the 225 h.p., 3-phase, 2,300 volt, 60-cycle induction motors, which drive the 150 kv.a. exciters.

The equipment of the induction motor panels is as under. one polyphase watt meter, controllers for oil switches, overload relays for the automatic control of the oil switches, and Tirrill regulators for the automatic control of the excitation voltage on the main units, these regulators being connected to the field rheostat of the 150 kw., d.c. exciter. The equipment of the two circuit feeder panel, which is for control of the power to the governor pump motors, is as follows: two polyphase watt meters, two oil switch controllers, and overload relays for the automatic control of the oil switches.

One of the three-phase 60-cycle single feeder circuit panels on the 2,300 volt board is for the control of a feeder circuit which feeds three 500 kv.a., single-phase, 2,300 volt, 220/110 volt transformers, these being used for supplying low volt energy for heating, lighting, and power throughout the plant. The other feeder circuit panel controls the feeder circuit which delivers 3-phase, 2300 volt energy for driving the blower outfits for supplying ventilation to the main generators. The equipment of these panels is: one polyphase watt meter, two oil switch controllers, and overload relays for the automatic control of the oil switches. The transformer panel in this 2,300 volt switchboard is for controlling a three-phase bank of transformers, made up of three 1,000 kv.a., 6600/2300 volt, single-phase transformers, which are to be connected on the high tension side to one 6,600 volt, 7,500 kw. generator circuit, stepping the voltage down to 2,300 volt, this transformer bank to be used as a spare capacity for the 2,300 volt excitation system in case of a shut down of one or more of the water wheel driven units. The equipment of the panel is as follows: the necessary instruments for measuring the power output of the transformer bank; controllers for oil switches on both the high tension and low tension sides of the bank; and the overload relay for automatic control of the low tension oil switches.

The control desk in the transformer house is to be arranged for the control of the necessary switch gear for four transformer banks, and will be divided into four sections, each being for the control of one bank. Corresponding to each section of the control desk will be a separate transformer instrument panel. The capacities of the transformer banks will be: two banks of 24,000 kv.a., each bank being made up of three 8,000 kv.a., single-phase, 60-cycle, 6600/110,000 volt transformers, and two banks of 15,000 kv.a., made up of three 5,000 kv.a., 60-cycle, 6,600/66,000 volt transformers, The equipment of each section of the control desk will consist of the necessary controllers for the oil switches on the transformer circuits and the ammeter switches, and potential receptacles for the instruments which are situated on the transformer instrument panel. The equipment of each transformer instrument panel is: one indicating ammeter, one indicating volt meter, one indicating power factor meter, one indicating frequency meter, one indicating watt meter, one curve drawing volt meter, one curve drawing watt meter, one curve drawing power factor meter, one watt hour meter, and synchronising device for the above curve drawing instruments, also relays for the control of the automatic oil switches on the transformer circuits.

It is interesting to note that the oil switches on the 6,600 volt circuits are to be Type H 6, which are designed for a normal voltage of 15,000 volts, and the oil switches used on the 2,300 volt circuits are to be type K 12 which are designed for normal operating voltage of 7,500 volts.

The engineers are Mr. R. M. Wilson, of the Montreal Light, Heat and Power Company (electrical), and Mr. Julian C. Smith, of the Shawinigan Water and Power Company (hydraulic).

The Niagara & Welland Power Company have withdrawn their bill. A request was recently made for an extension of time for the completion of certain of their works, but a protest by the Hydro-electric Power Commission of Ontario which claims the right to develop all power on the Welland Canal and use it for the people of Ontario resulted in the measure being withdrawn entirely.

The Power of Water in B. C.

By R. F. Hayward, Gen. Man. Western Canada Power Company, Vancouver

Much has been written about the value of the water powers of Canada, and much more has been written about the value of the great waterways of the Dominion, but attention has not been drawn to the greatly enhanced value of water powers which can be developed at deep tidewater.

It is well known that the British Columbia Coast has thousands of miles of protected deep waterways, but nobody knows how many hundreds of thousands of horse-power can be developed along the shores of the navigable inlets.

At some comparatively recent geological period the whole of British Colhmbia was covered with ice. The channels of the main glaciers are now the inlets of the coast line, and all along these channels there were numerous branch glaciers, which joining the main glacier high above the bottom of its channel, have scooped out basins in the side valleys which are now filled with fresh water lakes, discharging into the inlets over abrupt falls of anywhere from 100 to 300 feet in height. The lakes vary in size from a few hundred yards to 40 miles long, and the drainage areas which supply them vary from a few square miles to 400 or 500 square miles.

Somewhat modified conditions are found along the Fraser River, and further inland on the Thompson and Columbia Rivers, but practically all the important water powers of British Columbia are close to navigable salt water or fresh water. The water powers of the Coast Range not only have the advantage of being close to navigable water, but neither the water which produces the power, nor the water of navigation ever freezes up.

The rainfall of the Coast Range of British Columbia varies from 50 to 200 inches per annum, and is dependent upon the conformation and proximity of the mountains to the coast. What the precipitation amounts to in the high mountain ranges which form the upper parts of the watersheds, nobody knows, but sufficient rainfall data has been secured during the past twenty years to show that the annual precipitation over the whole Coast Range of British Columbia varies but very little from year to year. At a point about 50 miles inland from the mouth of the Fraser River, rainfall records, taken over a period of 20 years, show that in one year only, that of the great flood of 1894, did the rainfall vary from the average more than 16 per cent. In this particular year it was thirty per cent. above the average, and the floods along the Fraser River were unprecedented.

Favorable Conditions

This even precipitation, in combination with the large storage available in the lakes, the snow fields, and the glaciers, makes the water powers of the Coast Range very reliable. The proximity of water powers to navigable waters which are open all the year round, means that there is little necessity for expensive long distance transmissions and that, if the water powers are properly selected and developed, there is very little excuse for large auxiliary steam plants, which other less favourable conditions have made necessary throughout California.

These almost unlimited powers, with their constant supply of water which never freezes up, and their proximity to navigable waters which are open all the year round, are a source of enormous value to British Columbia, for, quite apart from the large cities, for whose supply ample power is already provided, these conditions give splendid opportunities for the establishment of all kinds of industries which require cheap transportation and cheap power in large quantities.

Industries for the manufacture of cement, nitrates and other chemical products, carbide, aluminium, wood pulp and paper, can generate their power at the back door of the factory, can bring their raw materials to their mill, by water, and can load their finished products at their front door on to ships that can sail to any part of the world, any day in the year.

Smelters can find locations at tidewater, where their ore, their power, their flux and their fuel are all close at hand; the conditions for the electric smelting of iron are ideal; and the time will come when the British Columbia Coast, from Vancouver to Prince Rupert, will be dotted with numbers of industrial towns such as those which have recently been established at the Powell River Pulp Mills and the Granby Smelter, from which their products will be shipped to all parts of the world.

The Government of British Columbia has wisely enacted laws which will prevent these valuable water powers from getting into the hands of speculators, and will thus preserve the use of the power for the best possible purposes. The Water Act was materially modified in the last session of the Legislature, and as it now stands it is probably as good an act, both for the protection of the interests of the Province and the bona-fide investor, as exists in any of the cities of the North American Continent.

Government Investigations

The Provincial Government has taken in hand the systematic investigation of the water powers of the province, and while the past two years have been chiefly taken up with organization, a large amount of useful work has already been accomplished, and in the course of years an individual or company who needs power for a bona-fide business will be able to secure all the preliminary information necessary for taking out a water record for the development of a power.

Those who have had to examine and develop new water powers in British Columbia, and know the great cost of investigating a watershed so as to get any reliable data upon which to base a development, will appreciate the value of the work which the provincial government is undertaking throughout the province, and in which the Dominion Government is co-operating within the Railway Belt.

While only an infinitesimal amount of the available water power in British Columbia has as yet been developed, the present requirements of the population are pretty well provided for, for the next few years.

The principal developments have been so fully described in the various technical journals, that it is only necessary to mention them by name here, they are:—

The West Kootenay Company's plant at Bonnington Falls.

The Vancouver Power Company's Lake Buntzen Plant.

The Vancouver Power Company's Jordan River Plant.

The Western Canada Power Company's Stave Lake Plant.

These were built for the supply of power to mines, railways, cities and general industrial districts. For purely industrial work, there is the large pulp mill of the Powell River Wood, Pulp & Paper Company about 75 miles north of Vancouver, and the Granby Smelting Company on Observatory Inlet about 100 miles north of Prince Rupert; also the hydro-electric plant recently established on Vancouver Island by the Dunsmuir Collieries, Limited.

Under construction there are plants for the supply of the City of Kamloops and the City of Prince Rupert, and various other developments are shortly to be undertaken, among which will be the hydro-electric plant for the supply of the power for operating trains through the tunnel which the C. P. R. are building under Rogers Pass.

Tenders are called for the completion of the power house building in Swift Current.

Hydro-Electric Power, St. Jerome

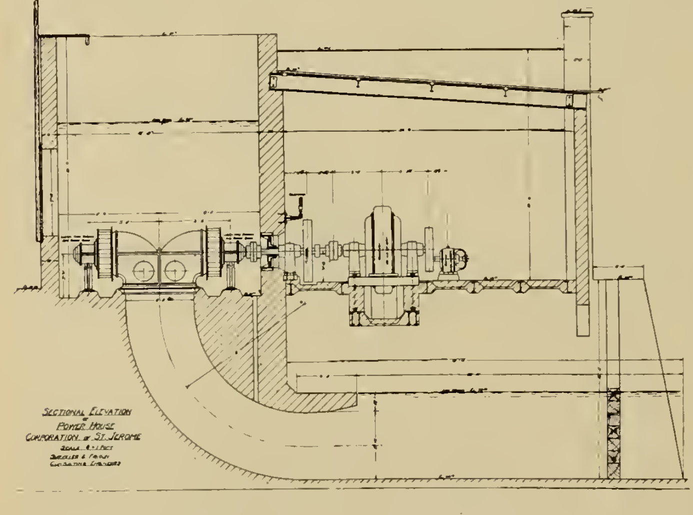
Progressive development of hydro-electric machinery has attracted not only capitalists, for good investment of superfluous capital, but also municipalities have commenced to build power plants of smaller capacities for accommodation of their citizens.

One of these municipal plants has recently been finished by the Canadian Allis-Chalmers, Limited, for the town of St. Jerome, P.Q., under the supervision of Messrs. Surveyor & Frigon, C.E., Montreal. The plant is situated on the North River, which carries its water from the Laurentian Mountains as a tributary to St. Lawrence River.

As low and high water conditions of this river are not unusually severe, the building of dam and spill ways, etc., did not demand extra precautions in the general design and construction.

The drop in the river at the point which was found best suited for the installation of the plant, is so low, however, that most careful methods in the design of flume, forebay and tail race had to be employed to obtain maximum output and efficiency of the generating station. The maximum head obtainable at the site varies from 18 to 21 feet, and as the ultimate capacity of the plant was settled at approximately 450 kw., the engineers decided on three units each at a maximum output of 150 kw. under the lowest conditions of head, namely 18 feet.

In order to obtain the above given head it was found necessary to build a small dam across the river, approximately 350 feet above the site of the power house. From there, the water is diverted into the wheel pits by means of a closed flume or pipe line. This pipe line is of reinforced concrete. It is 8½ feet in diameter with walls approximately 6 inches in thickness. The pipe line is set on solid concrete piers, so as to prevent settling and cracking. Where it enters the forebay (surge tank) it tapers out so as to allow the fast flowing water to decrease its velocity gradually until the water is received by the runners.



Section St. Jerome hydro-electric plant.

Dam

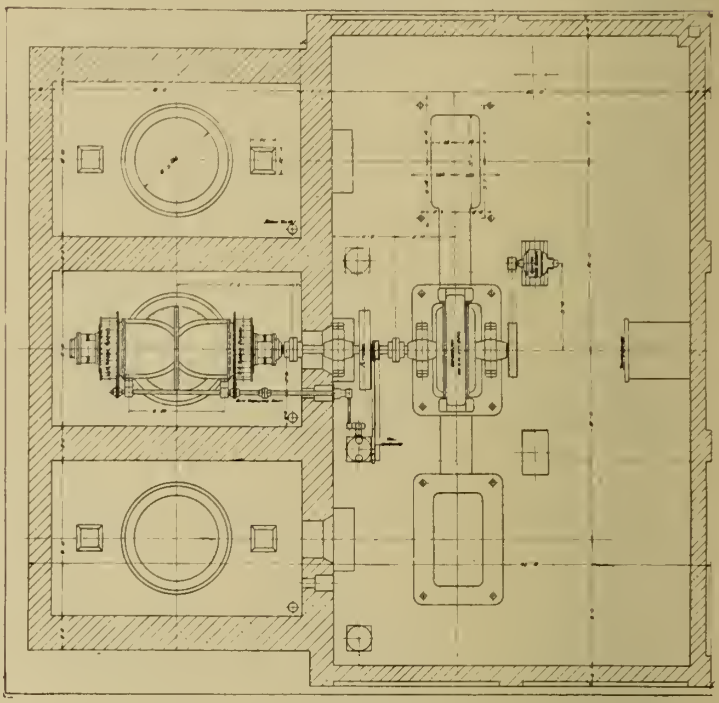
The dam work is of simple construction, of concrete, and designed partly as a spillway and partly as sluice dam with stop logs. At the intake to pipe line, a conical thimble of steel plate construction is placed behind the head gate. The head gate itself is of wood construction, and provided with hoisting apparatus for regulation. A steel rack is also provided to keep foreign floating material and rocks out of the conduit.

The surge tank is constructed of reinforced concrete in semi-circular shape, and its lower end forms a continuation of the wheel pit walls.

Three wheel pits are provided for, and the turbines are erected in two of these pits, the third being closed at present. These pits are provided with head gates and hoisting gears, so as to enable the operator to empty the pits at short notice. Drain valves and other auxiliaries are also provided The draft tubes are concrete.

Turbines

The turbines are of the twin open flume type, designed to have a maximum output of 270 h.p. at 277 r.p.m., and operating under 20 feet head. Each turbine is controlled by swivel gates which in turn are connected to two regulating rings by means of steel links. The regulating rings are operated by means of one rigid gate which is directly connected to the hydraulic oil pressure governor situated in the generator room. The unit as a whole is designed to be easily adjusted for lining, the shaft being separated just inside the wall plate at the front end.



Plan of St. Jerome municipal power plant.

All inside bearings are of adjustable lignum vitae construction, and besides being bolted to the top plates are rigidly supported upon the foundation floor. The runners are made of cast iron with buckets of steel plate, cast and welded into it. The runners are guaranteed for 80 per cent. at full gate and 82 per cent. at 3/4 gate opening. The outboard bearing placed inside the generator room is designed as marine type thrust bearing, and is set upon a heavy cast iron pedestal. The wall plate being of cast iron is furnished with a stuffing box with bronze glands and neck rings.

A heavy flywheel is set upon the distance shaft to assist the governor in proper regulation. The governor is of the oil pressure type, and of self-contained design. It is capable of handling the gate apparatus from full open to closed position within 1½ seconds. A powerful hand control is further provided with the governor.

Electrical Equipment

The electrical equipment consists of two 150 kw., three-phase, 60 cycle, 277 r.p.m., 6600 volt, a.c. generators, arranged for direct connection to the turbines. The exciters are two 10 kw. type K units, 120 volts, 1150 r.p.m., arranged for belt connection. The four panel switchboard of blue Vermont marble includes two panels for the control of the two generators, one for the control of the 2200 volt feeders, and street lighting feeders. There is also two 22 kw. constant current regulating transformers for the street lighting system; these are installed at St. Jerome. The distributing transformers consist of 25 oil-filled, self-cooled units, 2200 volt primary 110/220 volt secondary for house lighting and three oil-filled self-cooled units, 2200 volt primary to 550 volt secondary for power.

The sub-station at St. Jerome also contains three 100 kw., oil-filled, self-cooled, step-down transformers for reducing the transmitting voltage of 6600 to the distributing voltage of 2200. All 2200 volt distributing lines are double braided.

The length of the high-tension transmission line is 3 7/10 miles. Cedar poles thirty feet long are used outside the town limits and 35 to 40 feet long inside the limits. The circuit consists of three No. 6 B. & S. hard drawn, bare copper wires from the power house to the town limits, and No. 6 B. & S. triple braid, weatherproof wire from the town limits to the sub-station.

The distributing circuits are controlled by circuit breakers of the automatic type located in the sub-station at St. Jerome.

The city street lights consist of 175 100-watt tungstens, four amperes, and fifty 250-watt tungstens, four amperes, controlled by constant current regulators. A telephone line is also built between the sub-station and the power house.

Stand-by Steam Stations

By Mr. C. G. Spencer*

The object of a standby steam station at the end of an overhead transmission system is to provide a source of power immediately available in the event of an interruption in the transmission lines. An interruption often occurs with no warning, the abrupt failure of power being the first intimation of trouble. The reserve steam plant to be of maximum value in such a service must be designed to respond quickly to calls for power up to the limit of its installed capacity and to be able to carry the system load through a prolonged period depending on the ratio of installed capacity to total load, character of load curve and time of interruption, that is, whether on or off peaks.

An interest in this subject has been aroused in Toronto by occasional interruptions in the past necessitating recourse to candles, travel on foot and by a very active press. Niagara generated energy in reaching Toronto passes through a region at the easterly end of Lake Ontario which rivals the Tropics in atmospheric electrical disturbances, beginning in March and continuing for six months.

Sleet storms and high winds contribute to the operating man's interest in life for the remainder of the year. A catastrophe such as befell the lake boats last fall impresses us with the destructive force of the winds in the lake districts. For assured continuity a standby plant is required in Toronto for twelve months in the year.

This type of service imposes conditions that to be met successfully requires a plant differing radically from the central steam station usually met with. The first requisite and the one that must be uppermost in the mind of an engineer designing a plant for this service, is quick response to calls for power. The second and equally important requirement is ability to deliver power for an extended period. The third consideration is economic and one that the designing engineer cannot get away from, viz., initial investment, plant efficiency and operating cost.

This paper treats primarily with Toronto conditions. In discussing standby plants for Toronto the use of gas engines doubtless occurs to some present. A gas engine plant even in localities where natural gas is available, costs more for initial investment per kw. than a steam plant with turbines. With a producer plant added the cost is roughly two to one as compared with a steam plant. The ability to respond quickly from rest is not inherent in the gas engine. The question of using gas under steam boilers is treated more fully later on in this paper.

The choice of apparatus for this service admits of but little argument. The steam turbine from the smallest to the largest capacities costs less per kw. than the reciprocating engine. It might be argued that in a standby plant where efficiency is not of paramount importance that reciprocating engines running non-condensing would work out to advantage in the initial investment. This plan eliminates the cost of condenser tunnels and condensing apparatus. The extra boiler capacity required, together with the larger boiler and engine houses, however, makes this layout more expensive than turbines with condensers. The turbine can be put in service in much less time than a reciprocating engine; requires a smaller force per kw. to operate; occupies less space per kw.; requires simpler and less expensive foundations; costs less for operating supplies, such as oil, water, packing, etc., and the exhaust is not contaminated with cylinder oil. To sum up the comparison for this service the turbine is superior to the reciprocating engine in smaller initial investment, ability to respond quickly and reduced costs of operating labor and supplies.

Large Machines Best

In the selection of the number and size of units there is a big advantage in favor of the large machines. A standby plant would be manned by a small force, to minimize costs, which requires that turbines be put in service one at a time. It is very desirable to have the machines large to save delay in starting several small units. A large machine costs considerably less to install with auxiliaries and piping than two or more of the smaller machines of the same total capacity. For assured service it is a conservative policy to have sufficient installed capacity so that the station load can be carried with the largest machine out for repairs. Some standby plants are laid down, however, with but one large unit. A repair on this unit puts the entire plant out of commission. This question must be studied for each individual case, there being no general rule to follow.

The selection of the general type of condensing apparatus for Toronto conditions is simple. Condensers can be divided into two classes, surface and mixing. In the former the exhaust steam is condensed by coming in contact with metal surfaces cooled by injection water, steam not mixing with the injection water. In the latter type steam is condensed by mixing with injection water. As Lake Ontario is suitable for boiler feed and mixing condensers have been perfected to give as good a vacuum as surface condensers, there are no operating reasons for installing surface condensers for a standby plant in Toronto. The first cost of a surface condenser installation is roughly $3 per kw. greater than that of a mixing condenser installation for the same conditions. The condenser to be installed would, for these reasons, be of the mixing type.

Mixing condensers are still further divided between the low type and elevated type. In the former the injection water is drawn in by the vacuum but must be pumped out against atmospheric pressure less any slight draft tube effect in the discharge pipe. In the latter type, generally termed the barometric condenser, the water is drawn in by the vacuum and flows out by barometric pressure, the only work required by the pump being in overcoming the friction of flow. The elevated jet requires a longer exhaust pipe with a resultant drop in pressure and greater liability for leaks. The low jet is more compact and requires no structural steel supports. In a high jet it is necessary to provide for the removal of condensation from the horizontal exhaust pipe. This is done by means of an entrainor in which the high velocity exhaust steam picks up the water and carries it to the condenser head with resultant pressure drop or by means of a pump which adds to the complexity of the plant. It is a safe statement that for large units the low jet is to be preferred.

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*Mechanical Engineer, Toronto Power Company.

As the capacity of a turbine plant is so dependent on its being able to run condensing at all times the problem of adequate condensing water must be given very careful study. It is assumed in this discussion that a plant in Toronto would be located on the lake shore. Once the condensers are purchased the guaranteed terminal difference can be obtained from the builders. Having this, together with the builder's water rate for the turbine at maximum load and the highest temperature of injection water during the summer months, the cubic feet per second of water can be obtained. The area of the intake tunnel should be ample enough to give low velocity to the flow. With the severe winters of this region, the lake end should be well below the extreme low water mark. This insures a supply of water from under the ice in winter and lessens the accumulation of floating matter on the racks at all times. As a further protection against frost, it is advisable to extend the tunnel into the turbine room at the same grade as at the lake end. The overflow tunnel should be designed for low velocity of flow and the condenser discharge pipes be sealed to give the maximum draft tube effect in the condensers.

Power for Condensers

The choice of motive power for the condenser auxiliaries lies between steam and electricity. Modern practice tends more and more towards motor driven auxiliaries. The motors, highly efficient in themselves, are supplied with energy efficiently generated in the main units. Bleeder type turbines allow low pressure steam to be drawn from the shell after it has passed through the high pressure blades. A thermostatically controlled valve regulates the flow of this steam to maintain constant feed water temperature with no heat loss. It is impracticable to design a plant having steam turbine or engine driven auxiliaries exhausting into a feed water heater and to strike such a thermal balance that at times steam in large quantities does not go to atmosphere. Motor drive allows of quicker starting and removes the steam, exhaust and drip piping from the auxiliaries. A minor feature that anticipates a discussion of boiler equipment is in connection with superheat on reciprocating auxiliaries. It is an annoying condition for an oiler to have lubricators in superheated steam supplies to engines and pump that will not feed because there is no condensation. It is generally necessary to connect such lubricators to some water line of higher pressure than the steam line, usually the feed water system. For a standby plant, however, unless there is a storage battery in the system, motor drive is out of the question since the auxiliaries must be started before the main generating units.

Before leaving the prime movers a point should be brought out in connection with the generator cooling air. It is a wise precaution to provide a duct for drawing the air from outside the turbine room and from an area free from steam connections. The air should be screened before entering the duct as it is cheaper and easier to clean the screens than to put a generator out of commission for taking down and cleaning.

So far this discussion has dealt with apparatus in which the designing engineer has but little lee-way in the control of the overall station efficiency. Between 65 and 70 per cent. of the total operating cost of the plant is in the boiler room. For this reason big advances have been made in boiler room practice in the last few years.

There is really no opportunity for choice in the type of boiler to be used, at the present time. Recent legislation limits the size of all externally fired boilers to 72 inches. Water tube boilers practically control this field at the present time.

Larger Boilers

There is a tendency now towards larger boilers. This reduces first costs and results in slightly better efficiency. In selecting the number and size of boilers provision should be made to carry the station load with one boiler out for repairs. Boiler rating is based on 1 horse power for each 10 square feet of effective heating surface. In flash boilers a horse power is developed from each square foot of heating surface. Engineers are now endeavoring to increase boiler output as compared with former practice. Boilers are now commonly operated at 200 per cent. of rating over extended periods and even 400 per cent. of rating for short periods. Generating a horse power on 5 square feet of heating surface cuts the first cost of a boiler plant in half.

The only way to obtain this evaporation is by liberating sufficient heat under the boilers and designing to utilize this heat when liberated. Commercial designs of boilers do not allow of a sufficient grate area for hand firing at this rate although grates are installed 12 and even 14 feet deep. This condition, more than anything else, has brought about the recent developments in stokers which makes such operation possible.

This rapid combustion of coal demands radical departures from established practice in boiler settings, flues, stacks and draft arrangement. Forced draft is almost universally installed to provide air in sufficient quantity for the high rate of combustion. Boilers formerly were set close to the grates, five feet or even less being the distance from the firing floor to the tubes. Boilers are now set 10, 12 and even 14 feet above the firing floor. A larger conbustion chamber gives the gases an opportuntiy to become ignited and burned before coming in contact with the tubes. This adds to the boiler efficiency and lessens smoke. The only losses are from the radiation which can be made negligible by means of a well-designed and constructed furnace.

For a standby plant that must respond quickly and be low in first cost stokers with forced draft are a practical necessity. In order to handle the gases on overload operation the flues must be made proportionally larger than in established practice heretofore. Data on flue designs is hard to find and is for the most part empirical. Flues are seldom made too large. The trouble with most boiler plants that do not steam as they should, lies in restricted flue areas One-tenth of an inch water pressure at a boiler damper may be the lacking quantity preventing successful operation. When it is considered that two right angle turns in the path of flue gases introduces a pressure drop of one-tenth of one inch, the necessity for straight simple flues is obvious.

Stacks should be designed of ample cross sectional area for the same reasons as the flues. With forced draft a stack only high enough to deliver gases above the surrounding buildings and to create a natural draft sufficient to draw the gases through the setting producing a balanced condition in the furnace, is necessary.

In a standby plant economizers are not warranted and should not be considered.

In a turbine plant superheat can be utilized to advantage. A gain in from five to seven per cent. can be effected in plant efficiency by superheating the steam from 100 to 150 deg. F., especially where coal is as costly as in Toronto.

Reference has been made to feed water heaters. Feed water heaters should be installed, as they improve the efficiency of the plant very markedly and eliminate undue strains in boilers due to the introduction of cold water. A selection of type between the closed and open must be made. Open heaters are being used more and more. The first cost is less; they are more readily cleaned; the thermal efficiency is higher, the steam mixing with the water; they afford an excellent opportunity for introducing feed water treatment. Formerly open heaters were objectionable because they returned oil from the exhaust steam to the boilers. This objection is largely removed at present by the development of effective oil separators and the gradual substitution of turbine drive for auxiliaries. This turbine exhaust is free from oil. An open heater must be elevated above the feed pump suction. Supply water to the heater must be under sufficient head to reach the heater elevation. In Toronto this condition requires special pumps to elevate the lake water. For this reason closed heaters are often installed in plants where feed water is not delivered to the plant under pressure. The selection between open heaters with pumps and closed heaters must be studied and made for each plant.

Lake Ontario water is so low in incrusting solids that the simplest treatment renders it excellent for boiler feed purposes.

Feed pumps may be either reciprocating or centrifugal, the latter type having within the last few years been successfully developed for this work. In all cases the operation of feed pumps should be automatic. They should always be ready for immediate service without attention. A standby crew is sufficiently busy putting the plant into service from rest without having to worry about feed pumps. If a centrifugal feed pump is installed the same arguments in connection with steam turbines or motor drive hold good as with the condenser auxiliaries.

Piping is Most Important

The piping of a standby plant is most important. The service is very severe, especially if standby is not required during the night and steam is allowed to drop. It is much more difficult to keep a steam line tight if the pressure is alternately up and down than if the pressure is maintained constantly. For this reason joints are to be avoided and those that are necessary carefully designed. Simplicity is all important in laying out pipe work. The same applies through the entire station design. Complications and duplications that a few years ago were considered desirable are now being reduced to their simplest terms. One boiler feed line built as well and as strongly as modern methods and material permit is superior to a duplicate line in that the first cost is less; the upkeep is less; operation is simpler, and results show that trouble is no more prevalent.

Expansion, contraction, anchorage and drip must be well taken care of. Incorrectly designed steam piping is a source of unending trouble and expense to say nothing of the ever-present danger from a break.

If superheat is used in the plant cast iron fittings and valves must be omitted from the steam lines. Cast steel for fittings and valve bodies is the only successful material at present available for superheated steam. Monel metal is used for valve trimmings with good results. This combination is expensive in first cost but there seems to be no alternative.

The selection of pipe sizes should be made on a basis of velocity of flow for maximum condition of load. Rule of thumb methods formerly applied in selecting pipe sizes. Eight inch connections were recently removed from 184 h.p. boilers operated at about rating at the Scott street plant and replaced with three inch connections, the output having been raised about fifty per cent. by furnace changes.

In a standby plant condensation losses are large if pipes are not adequately covered. The efficiency of a non-conducting covering is mainly controlled by the amount the engineers decide to expend. It pays in lessened operating costs to do it thoroughly.

Coal and ash handling for standby plants is not as important as for plants operating continuously. It is better to keep a boiler room force busy handling coal and ash than to have them sitting around watching it being done by power. The force must be maintained and it is much better to have them busy than idle. This is a subject that must be treated for each plant. There is no general rule in this connection.

In determining the working steam pressure of the plant the tendency is towards higher pressures. Two hundred pound steam results in smaller pipes and apparatus as compared with equal capacity at lower pressure.

International Electrical Congress

In connection with the next Congress of the International Commission which is to be held in San Francisco in September, 1915, it is expected that the General Secretary of the Commission, Mr. C. Le Maistre, of London, England. will shortly pay a visit to Canada and the United States in order to get thoroughly in touch with local conditions and to make preliminary arrangements for the Congress.

Immediately following the Commission Congress there will be held an International Electrical Congress of Engineers, from all parts of the world and representing practically every branch of Electrical Engineering. The papers to be presented, which it is expected will be more than two hundred in number, will cover a very wide range of subjects, and will, of course, represent the most modern research and practice that is known to the world to-day. The Congress is authorized by the International Electrotechnical Commission, and is being held under the auspices of the American Institute of Electrical Engineers, whose President, Mr. C. O. Mailloux, of New York, has nominated the following as Honorary Canadian Members of the Committee on organization, namely.—Dr. L. A. Herdt, of Montreal; Prof. L. W. Gill, of Kingston; Mr. O. Higman, of Ottawa, and Mr. A. B. Lambe, of Ottawa.

Hydro Plant for St. Agathe

The Municipality of St. Agathe, P.Q., are about to instal a hydro-electric plant, designed by Ouimet and LeSage, Montreal. At present there is a small plant of 150 h.p., but this will be abolished, and one of 500 h.p. constructed. The present plant is mainly for lighting purposes; tungsten lamps are used—while the new equipment will be practically all for power purposes, there being a demand for electric energy for several industries which have been established. The development will be on the North River; the power house, of concrete, will measure 30 x 40 ft. The current will be distributed direct from the power house to the various mills, etc. The penstock is to be 1,000 feet long and 6 ft. 3 in. in diameter, and will be built of Georgia pine or B. C. fir. The plant will consist of two units, each of 250 h.p. The horizontal turbines, of Canadian Allis-Chalmers make, will operate under a head of 50 feet of water, working at 600 r.p.m. The oil governors are of the Bell type, supplied by Canadian Allis Chalmers, Limited. The dynamos will be of the alternating current type, 150 kv.a., 60 cycle, 2200 volt, 600 r.p.m., direct connected to the turbine; while the exciters, 125 volts, will be belt driven. There are to be four transformers, two for the potential and two for the distribution system, with the usual panel board and auxiliary equipment.

La Compagnie de Bois et de Construction, Limitee, St. Agathe, P.Q., have obtained the contract for the above work.

Electrical Drive of Winding Engines and Rolling Mills*

By C. Antony Ablett, A. M. Inst C. E., and H. M. Lyons, A. M. I. E. E.

The use of electrical machinery for driving hoisting engines in mines and reversing rolling mill plants in steel works is comparatively recent, the first winders of importance having been introduced in 1902, and the first electrically driven reversing rolling mill being installed in 1906, though non-reversing rolling mills were driven electrically some eight or ten years earlier. The developments along these lines have been extremely rapid, as is shown by the fact that at the present time about one thousand large winding engines and nearly sixty reversing rolling mills are being driven electrically, and still greater developments may be expected in the future.

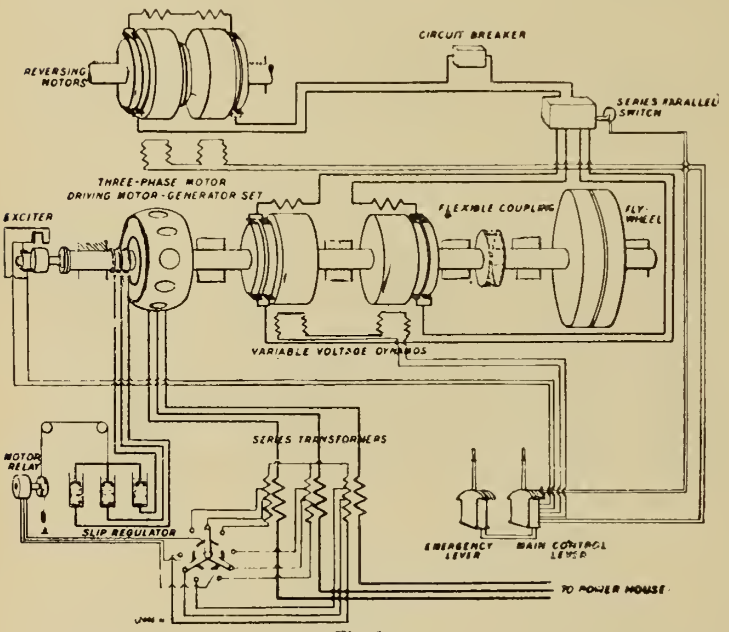

Fig. 1.

The earlier winding engines were extravagant in power and had the disadvantage of drawing very heavily upon the source of electrical supply at the moment of starting. It was, therefore, impossible to use them on systems where the supply of current was limited, and even on comparatively large plants their use resulted in serious interference with other machinery. These disadvantages were, however, practically done away with when the Ward Leonard system and Ilgner's adaptation of the flywheel to this system were introduced, but the last few years have seen greater improvements in the Ward Leonard and the Ilgner system.

The present paper will deal chiefly with the developments of these systems by the various Siemens Companies, who have installed about half the total plants in existence, and with whom the authors have the honor to be associated.

WARD LEONARD SYSTEM

A short description of the so-called Ward Leonard System, illustrated in modified form, by the addition of a flywheel, in Fig. 1, is desirable as an introduction. In this system a direct current motor is used to drive the winding engine or rolling mill, the motor being supplied with power from a direct current dynamo, and the essential feature of this system is that the voltage supplied to the motor, and consequently the speed of the motor, is controlled by controlling the field current of the generator, instead of by varying the resistance in the armature circuit of the motor. Thus, as the field current of the generator is increased from nothing to a maximum, the motor speeds up from standstill to full speed, and if the field current of the generator is reversed, the motor reverses its direction of rotation.

This system enables a very exact control of the speed to be obtained, because the speed of the motor is practically proportional to the strength of the generator field, whatever the load on the motor may be, while with any control system where resistances are inserted into the armature circuit of the motor, the speed would vary within very wide limits with a change of load, rendering the exact speed control quite impossible. The control of the dynamo field involves scarcely any waste of electrical power, but where resistances are inserted into the armature circuit the loss of power may be, and usually is, very great.

The field currents of the generator are small, so that the control mechanism is small, compact and very easy to handle. The armature currents are perhaps fifty times as great, so that any control mechanism which varies the resistance of the armature circuits is large, clumsy and difficult to handle, in fact, a complicated relay system is often necessary to enable it to be handled at all.

The dynamo used to supply the motor in the Ward Leonard system is usually driven by a motor supplied from the available power circuit, forming a motor-generator set, and this motor may be either direct current or three-phase, according to the power available. The dynamo may be and sometimes is driven by an engine, water turbine, or other prime mover, if this happens to be more convenient.

Application to Winding Engines and Hoists

Speed Control.—The main control lever for operating the winding engine is coupled to the regulating resistance in the field circuit of the generator, so that when this lever is in the mid position there is no current in the generator field. As the lever is moved in one direction the generator field current increases, and as it is moved in the other direction the generator field current is also increased, but in the opposite sense. From what has been said in the introductory remarks it will be seen that when the lever is in the mid position, the winding engine is at a standstill, and that it starts and speeds up as the lever is moved from the mid position in one direction, while if the lever is moved from the mid position the other way the winding engine increases in speed in the other direction, and that the speed of the winding engine is practically proportional to the displacement of the lever from the mid position, and is not affected by the weight of material being hoisted.

The driver has not absolute control over the speed, for two cams are provided on the depth indicator, one for each cage, which operate levers coupled to the control lever in such a way as to prevent the cages being accelerated at too rapid a rate, and to slow up the winding engine at the proper point so that the bank is approached at a crawling speed. Provided that these limits set by the cams are not exceeded the speed of the wind is entirely within the driver's control. The depth indicator and the cams are positively driven from the drum of the winding engine and the cams are so geared that they make less than one revolution per wind.

Use of Flywheel.—Fig. 2 shows the typical horse power diagram for a winding engine. The inertia of the drums, cages, head sheaves, material wound, and the ropes, which altogether weigh about 60 tons in this particular case, necessitates a horse power at the end of the acceleration period of each wind of 1865, which is about three and a half times the average power demand of the winding engine, in this case 524 horse power, and it is found that the maximum acceleration peak is usually between three and four times greater than the average demand.

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* Presented before the Can. Soc. C. E.

The consumption of energy for this Ward Leonard control rises gradually during the starting period, and the maximum is only reached at the end of the time of acceleration, i.e., from ten to fifteen seconds after the start, because the speed of the winding motor is increased while it is giving the requisite turning moment by increasing the field of the generator, and consequently there is no loss of power in starting.

Since the acceleration peak is of short duration and only comes on gradually, it is possible to supply Ward Leonard winders from power stations of comparatively small total output, provided that the machines in the power station have a sufficient overload capacity to maintain their speed during peak loads, as is usually the case with steam turbo-generators where the generators are provided with modern voltage regulators.

Where, however, this is not the case, and the acceleration peaks of the winding engine are large compared with the average demand on the power station, or where the winder is supplied through a long transmission line from a distant power station, it is sometimes necessary to couple a flywheel to the motor generator set.

This is the Ilgner system, so-called after the engineer who first used it in practice.

Fig. 3 illustrates the effect of the flywheel in equalizing the load taken by the winder, where it will be seen that the current taken by the winding motor varies between + 1900, and — 1000 amperes, while the current taken from the supply system is maintained practically constant at 400 amperes, the maximum voltage supplied to the winding engine and the supply voltage being the same.

The following example will give an idea of the power taken by the Ilgner system under practical working conditions with a winding engine arranged to wind 240 tons per hour from a depth of 1960 feet, making as a maximum 14½ winds per hour, where the flywheel is used whenever the full output is being wound at the full speed, but where a lesser output is being wound at reduced speed, so that the acceleration peaks become less serious, the flywheel is uncoupled to save power. These results are conveniently expressed in terms of the kilowatts taken by the electric winding engine plant per shaft horse power.

	Output in tons per hour.	Kilowatt per Shaft Horse Power.
With Flywheel	240	1.49
“	160	1.60
“	108	1.77
Without Flywheel	160	1.35
“	108	1.48

It will thus be seen that when working the winding engine on the Ilgner system there is an increased loss of power of from 16 per cent. to 17 per cent., as compared with the Ward Leonard system, and naturally with the latter where the flywheel is uncoupled the resistances are cut out of the rotor circuit of the three-phase motor to avoid loss of power.

To avoid misunderstanding of the above results, it should be specially pointed out that shaft horse power is taken to mean the actual work done in raising the load, i.e, if the actual weight of coal or ore, expressed in lbs., which is raised per minute is multiplied by the depth of the shaft in feet, and divided by 33,000, the shaft horse power is obtained. The shaft horse power thus does not include the mechanical friction of the winding engine, the sheaves, the guides or the rope losses, and the figure of the kilowatts divided by the shaft horse power brings in the mechanical efficiency, as well as the electrical.

Details of Ilgner System

Of recent years the capital cost of Ilgner plants has been greatly reduced, owing to the adoption of higher speed for the motor generator sets and to the improvements in the manufacture of such fly wheels, which enables them to run at very high peripheral speeds compared with those used in the earlier winding engines.

For example, the provision of flywheel capacity to equalize peak loads of 60,000 horse power seconds, in the early days of Ilgner winding, where peripheral speeds of 15,000 feet per minute were used, would require two flywheels of a total weight of about 80 tons, the friction and windage loss of which would be about 150 horse power. Under modern conditions where the regular peripheral speeds are 27,000 and 30,000 feet per minute a single flywheel of 22 tons weight would be used, instead of the two flywheels having a total weight of 80 tons, and the friction and windage losses would not exceed 100 horse power.

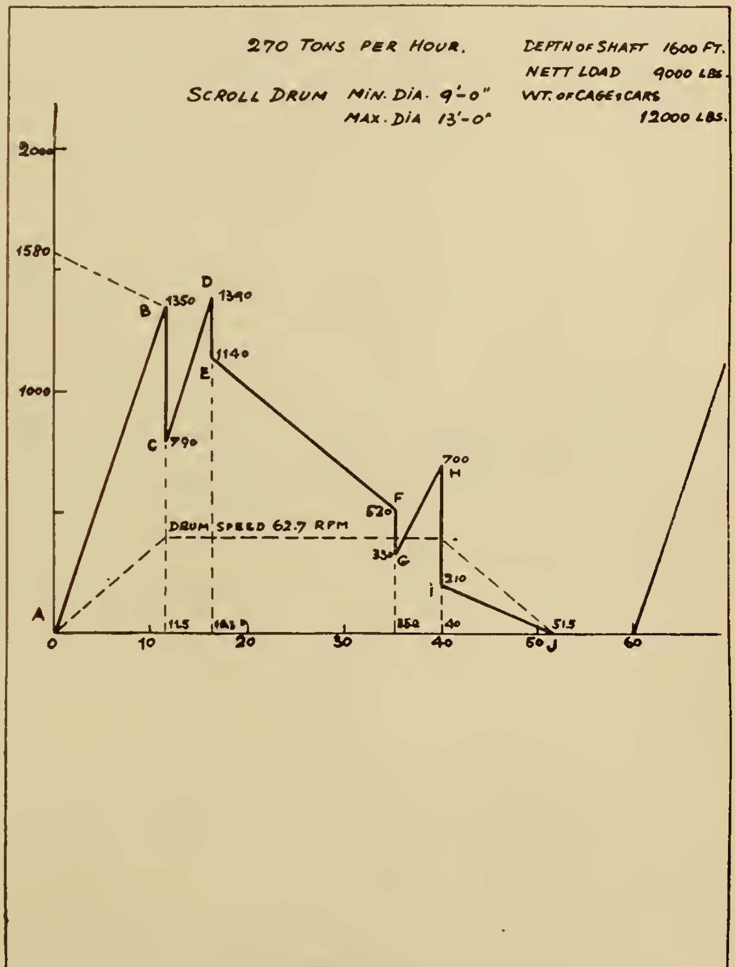

Fig. 2.

The Ilgner system was used on practically all the early European winding engines, but as at the present day power stations are being installed of much greater capacity than those of a few years ago, and high speed turbo-generators of large overload capacity are being adopted, the Ward Leonard system at the present time is being used to a much greater extent than the Ilgner system for winding engine work.

Generally speaking, the Ilgner system of winding may be preferable to the Ward Leonard system in the following cases:—

(1) When the time occupied by the wind is short.

(2) For vertical shafts.
(3) For large outputs.
(4) Where the winding speed is very high.

The above conclusions may be considerably modified by the nature of the electrical supply. Where the power station is small or the winder is supplied through a transmission line of considerable length, the Ilgner system will be more suitable, but where the power station is large and near the winder, the Ward Leonard system is the better.

Brake Gear

The mechanical brake is so arranged that when it is required to bring it into action it is actuated by a weight at the end of a lever, but it is normally held off the drum by an air cylinder.

Under normal conditions the cams on the depth indicator actuate the control lever, so that the cages approach the bank at a very slow speed. When they reach the bank the driver brings them to rest by means of his control lever, and then puts on the mechanical brake to hold the cages in position by means of the brake lever. The brake lever is interlocked with the control lever, so that the driver cannot put on the brake by means of the brake lever until the control lever is at about its middle position, i.e., unless the cages are moving at a comparatively slow speed.

To enable the driver to stop the winder in case of any emergency arising, a third lever, the emergency lever, is placed on the driver's platform and if this is operated it puts on the mechanical brake through the emergency gear and at the same time cuts off the excitation from the dynamo of the motor generator set.

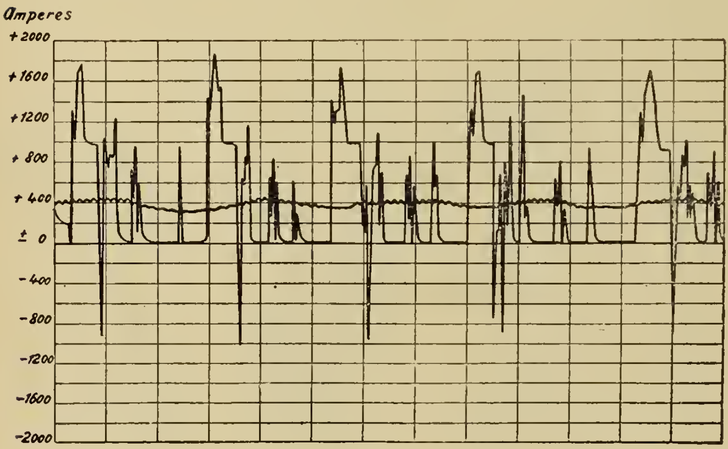

Fig. 3.

Safety Devices

As mentioned above, cams are provided on the depth indicator which keep the acceleration within safe limits, and the cage is brought gradually to a slow speed by the time it reaches the bank. An overwind device is provided, usually both on the depth indicator and in the shaft, which puts on the mechanical brake through the emergency gear and cuts off the excitation should the cage overwind the bank, thereby bringing the winding engine instantly to a stop. Should the air pressure or the excitation fail, the mechanical brake is put on by means of the emergency gear.

When men are being wound the throw of the main control lever is limited by means of a switch on the bank, so that the winding engine cannot be run above a certain speed.

Where electrical driving is adopted it is very easy to provide safety devices, and all those mentioned are designed to protect the plant against careless handling, but if the majority of safety devices were dispensed with, the Ilgner and the Ward Leonard winder would still be better protected against careless handling than the steam winder. The fact that it is impossible for an Ilgner or a Ward Leonard winder to race or run away makes it inherently safer than the steam winder.

Application to Reversing Mill

Nearly 60 large reversing mills are being driven electrically in different parts of the world and a modification of the Ward Leonard system has been installed in almost every case to meet these special requirements.

The power requirements of a reversing rolling mill impose much more severe conditions on the electrical plant than those of a large electrically driven hoist. With a large 36-in. or 45-in. blooming mill, ten to twelve passes are often made in a minute, and the power during individual passes may rise to 12,000 h.p. or more, while the total time of the passes, i.e., the total time that the ingot is between the rolls, is very short compared with the total time taken to roll an ingot down to a bloom or billet. It is thus easily seen that the average power required from the power station is very much less than the maximum power which the mill motor has to give.

For example, in many electrically driven blooming mills, the average power is only one-sixth or one-seventh of the maximum power.

In the case of an electrically driven hoist, the duration of a wind would be perhaps one minute, followed by a pause of 20 seconds or so, and the maximum power required seldom exceeds 3,000 to 4,000 horse power, so that the average power is of the order of one-third of the maximum power. While, as has already been pointed out, it is frequently necessary to employ flywheels with winding engines it is always necessary to couple a flywheel to the motor generator set which supplies a reversing rolling mill motor.

A reversing rolling mill motor, on account of the rapidity with which it has to reverse, must be so designed that its moment of inertia is kept down to a minimum and special precautions must be taken to see that the field of the generator supplying this reversing motor should build up as rapidly as possible. This has been accomplished so successfully that it has been found possible to reverse a large reversing mill motor having rotating parts weighing over 70 tons, 30 or 40 times per minute between a speed of 60 revolutions in one direction and 60 revolutions in the other, when no steel is being rolled. Such tests naturally cannot be made while steel is being rolled because it would be quite impossible with the present type of live roller tables to return the ingots to the mill quickly enough, but such tests are useful in showing the very high rate of acceleration of the mill motor which can be obtained, and as a measure of the handiness of the mill.

Power Diagram for Reversing Blooming Mill

Under ordinary conditions the power diagrams for each wind of a hoist are identical and can be calculated with considerable exactitude from the conditions of working, but with a rolling mill the power diagrams for each pass vary very greatly from one another, and cannot be calculated with any accuracy, for the following reasons.

During the earlier passes heavy drafts are taken but the ingot is quite short, consequently large powers are required for very short times; but as the ingot is gradually rolled out to a bloom of considerable length and reduced in section the drafts are diminished, as the reduction in area must be kept moderate, otherwise the bloom is damaged by the formation of surface cracks, etc., so that during the last passes the necessary power is not very great, but it is required for a considerable time.

During the first two or three passes the ingot still has its tapered shape and the metal is very spongy in character, so that the powers required are not very heavy and are very irregular. By the time that the last passes are taken the bloom has cooled down considerably and while this cooling increases the specific power required, such drafts are taken that the power required for these passes remains much less than that for the first passes.

Action of Flywheel

There is a great difference between the behaviour of the flywheel coupled to the motor generator set used for driving a hoist, and that used for driving a rolling mill. In the case of a hoist where the power diagrams for each successive wind are almost identical, and about an equal period elapses between each wind, the flywheel gives up power during a wind and regains it during the interval, thus serving to equalize the power between individual winds and intervals. In the case of a rolling mill, and particularly a blooming mill, the flywheel has to do a double duty, because during the first passes made on an ingot the mill motor has to give a large power for a very short time as the ingot is short, so that the energy consumption during the earlier passes is much less than the energy consumption during the later passes, where, although the power given by the motor is not so great, the ingot has been rolled out to a considerable length, so that a very considerable energy is required per pass. The flywheel, therefore, has to give up energy during the passes and regain it during the interval between passes, and also the flywheel gains energy during the first passes of an ingot and loses energy during the later passes, so that its speed variation has a double period, namely, a short period of about 5 to 10 seconds, corresponding to the partial equalization of power between the pass and interval, and a long period of about 3 minutes, corresponding to the equalization of power over the whole time of rolling an ingot.

As the flywheel used in connection with a rolling mill has to equalize the power over a period of three minutes or so, it is usually found that these flywheels are much heavier than those applied to winding engines. The motor generator set for a blooming mill is usually supplied with a flywheel weighing about 40 tons, while a motor generator set provided for a plate mill, or a finishing mill, is generally supplied with a flywheel weighing anything from 60 to 100 tons, depending on the work which has to be done. The motor generator set for supplying hoists or winding engines is generally provided with a flywheel of not more than from 20 to 30 tons. Such flywheels would run at a peripheral speed of about 20,000 per minute, though in some cases this peripheral speed has been considerably increased.

Such a 100-ton wheel running at this speed would have a stored energy of about 300,000,000 foot lbs. or 545,000 horse power seconds, and in falling 20 per cent. in speed would give up 108,000,000 foot lbs. or 195,000 horse power seconds.

The total work required to roll a 1½ ton ingot to a 4¾ x 4¾ billet is 59,000,000 foot lbs. or 108,000 horse power seconds.

Safety Devices

The safety devices provided for an electrically driven rolling mill are of a much simpler character than those provided for a hoist, because it is not necessary to provide against the possibility of an overwind or the loaded cage falling to the bottom of the shaft due to the failure of the electric power. It is only necessary to protect the electrical plant and the mill itself against careless handling.

A circuit breaker is provided in the main circuit between the generator of the motor generator set and the mill motor to cut off the power from the motor in case, through carelessness, an attempt is made to roll a cold ingot, or too great a draft is taken on an ingot, imposing a greater strain on the motor and mill than they were designed for.

The circuit breaker is a protection against broken rolls as well as against damaging the motor, and it must be remembered that many rolls, especially the bottom roll, have a very small factor of safety. Such a circuit breaker would be most objectionable if used with a hoist, as only the prompt application of the brakes would prevent the cage falling in the shaft when the breaker opened, but with a mill, when the circuit breaker acts the motor merely comes promptly to a standstill, and if there is an ingot between the rolls, the mill can be reversed, the circuit breaker put in, the ingot run out of the mill again, and no damage is done.

A good deal of space in this paper has been devoted to description of safety devices but it should not be considered on this account that there is any inherent risk in using such electrical plant, as the safety devices are to protect the plant against damage due to careless handling. The devices applied to steam hoisting engines, and particularly to steam reversing rolling mill engines, are of a much more rudimentary description, and the safety of such steam plants really depends on the skill and experience of the driver.

It should be particularly pointed out that the electrically driven reversing mill does not increase in speed as the ingot passes out of the rolls, while the steam engine, unless carefully handled, will race and run away.

APPLICATION OF THREE-PHASE MOTORS

A three-phase motor cannot be built for a very low speed without its power factor being bad, which tends to upset the regulation of the supply system, and for this reason where three-phase motors are driving winding engines they nearly always run at higher speeds than the drums, and are geared to them. In the Ward Leonard or Ilgner system, however, where a direct current motor is used, this is almost invariably direct coupled to the drum.

Control

The speed of a three-phase motor is controlled by varying the resistance in the rotor circuit so that all three-phase winding engine motors are naturally slipring motors, while the direction of rotation is reversed by interchanging two of the connections to the stator, so that a reversing switch must be provided for this purpose. In order to explain the differences between the control of a three-phase winder and that of a Ward Leonard winder, it is necessary to refer briefly to the behaviour of a three-phase induction motor when resistances are connected in the rotor circuit.

If the proper resistances in the rotor circuit of a three-phase induction motor are connected to reduce the speed by a given amount for a definite turning moment, the speed of the motor will increase if the turning moment which it has to give decreases, and it will decrease if the turning moment increases. It will thus be seen that while with a Ward Leonard or Ilgner winder, the winder runs at a definite speed for each position of the control lever, and the speed of the winder is independent of the load in the cages, with a three-phase winder the speed does not solely depend on the position of the control lever, but also depends on the turning moment which the motor has to give, so that for a definite position of the control lever the speed may vary according to the position of the cages in the shaft and according to the load that is being hoisted, for as the loaded cage is being hoisted, its weight becomes more and more balanced by the weight of the rope attached to the empty cage.

With the three-phase winder, therefore, the manipulation of the levers would be different as different loads are being hoisted, and it is therefore impossible to employ cams on the depth indicator to limit the acceleration and to bring the loaded cage to a slow speed by the time it reaches the bank.

In the three-phase winder, therefore, we come back to the case of a steam engine where the wind is entirely in the hands of the driver and reliance must be placed in his skill for the safe handling of the plant.

(To be continued)

Electric Railways

3-phase Railway Operation in Italy

Details of the latest developments in 3-phase railway electrification on the Italian State Railways have recently been published in the official journal of that Government. We are indebted to "The Tramway & Railway World" for the following translation:—

So far as Great Britain is concerned the developments of electric traction upon main line railways have taken the direction of employing in nearly every case a third rail as conductor and continuous-current motors. Indeed, so far, the bold step taken by the London, Brighton, and South Coast Railway, in converting their suburban lines to electric traction upon a single-phase alternating-current system of line working, with overhead conductors throughout, constitutes the chief instance at present of such a method in regular service in this country; but its apparent success in working justifies extension, and it may be that in future more examples of the system will be put into operation upon long-distance runs, as well as for sections where traffic is heavy and junctions numerous.

The Italian railway authorities, perhaps partly because of the success of three-phase alternating-current working upon the Valtellina line, have continued to install the same system on other lines in preference to third-rail continuous-current working, and we have now to record the progress of further stages in the equipment of the main lines of the Italian State Railways near Genoa for electric traction, with overhead conductors and alternating-current motors.

The new method of traction has already practically doubled the tonnage per hour of the line where at present working. The average trains consist of 21 wagons of 18 tons each. The line is divided into three sections, and the trains run at intervals of 15 minutes. With a period of 18 hours per day there are, therefore, 1,058 wagons running over the line, or with a period of 20 hours per day, 1,176 wagons can be dealt with. At a 10 minutes' interval these figures are increased by 50 per cent.

The 40 locomotives for the line represent the latest developments in three-phase machines. Each has a capacity of 2,000 h.p., and a total weight of 60 tons; this, of course, represents an output of 33.3 h.p. per ton. These locomotives have five coupled axles with wheels of 42 in. diameter. The two axles at each end have a lateral play of ⅞ in. The central wheels have no flange—an arrangement which allows the locomotives to run freely round curves of every small radii without difficulty.

As delivered, the new Giovi locomotives were designed for freight service, and for a normal speed of 28 miles per hour. They are, however, also used for passenger service, as their speed capacity is as high as it is considered safe to work on the Giovi line. They have, in addition, a 14 miles per hour speed which is used for shunting purposes and for generating power when the train is running down hill.

Trains of 418 tons, exclusive of locomotive weight, have been run at speed of 28 miles per hour up the grade from Pontedecimo to Busalla, a distance of 6½ miles. On the down grade, as mentioned, the speed is 14 miles per hour, the locomotive being connected for regenerating power. During the original tests after 20 hours' continuous operation, one round trip without forced ventilation of the motors was made with a temperature rise of the motors to somewhat less than 167 deg. Fahrenheit. The one-hour motor rating for the same temperature is 720 h.p. per motor, corresponding to a locomotive pull at the wheel circumference of 19,500 pounds. The friction rating under the most unfavourable conditions is such that a train of 380 tons, exclusive of the locomotive, can be accelerated to 28 miles per hour in less than 200 seconds by two locomotives, one pushing and one pulling, on a grade of 1 in 28.6, and on a curve of not less than 1,200 ft. radius. The maximum starting torque is such that the motors can revolve the wheels of the locomotive, with its weight increased to 75 tons, while the locomotive is kept stationary.

The motors are three-phase, 3,000-volt, 15-cycle machines, arranged to run in cascade and parallel, giving two synchronous speeds of 112½ and 225 revolutions per minute. Intermediate speeds are obtained by inserting rheostats in the circuit. The motors have double bearings, the outer of which is built into the main locomotive frame and carries the reactions of the frame; it also takes the thrust of the connecting rods, and is provided with springs to take up all motion or change of position due to shocks, weight of ballast on locomotive frame, etc. The inner bearing carries the motor, and has for its special function the maintenance of the air gap, so that the motor itself is entirely independent of any motion of the locomotive frame. The mounting of the motors on the locomotive is accomplished from below by means of a hydraulic lift. The complete changing of a motor, including the connection to the side rods, may be easily done in two hours.

Control System

The control system embraces a number of excellent features. Since the starting resistances are of water rheostat type, it was necessary to design the secondaries of the motors for low potential; this was also desirable in order to have low potential on the slip rings. The low potential secondaries involve, however, the possibility of connecting one of the motors in cascade connection. The switch performing this reconnecting of one of the stators from high to low voltage is the only switching mechanism in the system, which has numerous contacts for heavier currents. It can in this respect be compared with either the auto-transformer tap switch of the single-phase system and poly-phase systems with squirrel-cage rotors, or with the resistance distributing switches of systems using metallic starting resistance; but its practical operating characteristics are much superior. Since it is always operated without current the necessary care and cost of maintenance is reduced to less than 10 per cent. of that of the other switches mentioned, and it may be operated by only two relays, while the others, under master-switch control, require relays for all tappings.

The wiring required in connection with the potential changing switch is reduced to a minimum by mounting the switch directly on the motor and handling it as a unit therewith. The switch extends into the cab of the locomotive from below, and may be readily inspected by removing the protecting cover.

The use of the water rheostat is one of the main advantages of the control system. It eliminates all metallic resistance parts, which are always more or less subject to burnouts and mechanical breakage. Moreover, all contacts that have to be operated under current in the secondary are eliminated, excepting the one contact which short-circuits the rheostat. On this contact, however, there is no arcing and burning, since it operates only when the water rheostat is about zero.

A further advantage of this control lies in the fact that it does not increase the current by steps, but allows for the finest possible regulation.

The water receptacle is a tight tank so mounted as to extend below the cab for air cooling. Receptacles for the electrodes extend from below the water level, through the cover and up into the lower parts of the locomotive, the electrodes being supported in the upper portions of these receptacles or cylinders. In operation, the height of water in the cylinders is regulated by air pressure in the upper part of the tank, which forces the water up into the cylinder, and the regulating mechanism extends into the cab proper, and can therefore be conveniently inspected after the removing of a protecting cover.

The only switch that is interrupted under current is the primary switch, but even for this switching conditions are very favourable, as the current to be interrupted in the primary of induction motors with wound secondary may be reduced practically to the magnetising current by first inserting resistance into the secondary, and then breaking the primary current. For this reason it has been found possible to use switches which, after an operation of two years, are still in good working condition. The excellent feature of the primary of the Giovi locomotive is that it serves as both an interruption switch and a reversing switch, without requiring any additional contacts for the reversing. This is accomplished by simply rotating the movable contact parts through a certain angle, in order to reverse the motor.

The master switch is arranged for two levers. One of the two levers has four definite positions, corresponding to the two speeds, to move forward and backward. The second lever regulates the current consumed by the motors. Every position of this lever determines positively the certain maximum current to be taken by the motors. Any time the motor tends to take current larger than corresponding to the lever position, resistance is automatically inserted into the secondary. The lever acts on the armature of a small induction regulator, and thereby regulates the secondary potential of the regulator; the induction regulator secondary is connected to one coil of a relay, which is counteracted by the second coil, the current of which is proportioned to the motor current. Whenever the effects of the relay coils are balanced, the armature is in the middle, and the motor currents remain unchanged; as soon as the motor current increases the armature is attracted by the one coil, and closes the relay circuit, which increases the resistance in the secondary. The fact that each locomotive can be set for a maximum current would make it possible to use the locomotives in multiple without a special multiple control. Nevertheless, a multiple-control arrangement is provided for. The special controller, allowing for all desired conditions, is provided in connection with this system. The multiple-control system not only permits the operation of locomotives of different wheel diameters in multiple and equally loaded, but also permits the loading of them differently with any desired ratio of load distribution. This is a great advantage, as it is frequently desirable to keep the drawbar pull of a pulling engine within certain limits, and let the pushing engine take care of the greater part of the load.

The coils operating the valves are of a very simple design, and work exceptionally well, even if the potential drops to half its normal voltage.

An important feature—already alluded to—of the three-phase installatilon has been found of great value in the utilization of regenerated power from the descending trains; this reduces the cost of operating the line, and also reduces, by proper arrangement of the schedules, the peak of the load in the generating station, further avoiding the use of mechanical brakes when the train is going down grade.

Pantograph Arrangement

The pantograph arrangements are also very simple. The single bow with two bronze cylinders insulated from each other and revolving in ball bearings engages both overhead wires. The use of the rolling contacts is very favourable for the contact wire, and has given good results on the Valtellina line, where it has been in use for over 10 years. On this line the rolling contacts were changed after an average of 25,000 loco-kilometres (not including shuntings), with a current often greater than 200 amperes per contact. In the Simplon tunnel, where sliding contacts are used, they were changed after 2,700 loco-kilometres on the average. This great difference is due to the fact that the contact point on the rolling type is changing very rapidly, so that the melting of the metal which reduces the life of the contact on the sliding type is not possible.

The construction of the trolley line is identical with that actually in service on the Simplon line. It consists of two wires of 5-16 in. diameter, suspended over the centre of each of the two tracks, supported by transverse wires carried upon steel poles placed upon each side of the track. The rails are electrically bonded and connected with the substations, and serve as a third conductor.

Transmission Line

The transmission line consists of a double feeder cable from one extremity of the route to the other. It has been erected with all the latest improvements for the use of 13,000 volts. It feeds four transformer stations, situated on the route between Genoa and Ronco, at Rivarolo, Pontedecimo, Montanesi, and Busalla. Each of these consists of a small building of brick and concrete, containing a three-phase transformer of a nominal capacity of 3,600 kv.a. of the oil type, reducing the current from 13,000 volts to 3,000 volts tension for feeding the overhead wires. The transformers, which are only designed for 13,000 volts, can, by a change of the connections, be adapted to 22,000 volts. When this change becomes necessary a third group can be installed in the central station, and three alternators arranged for working at 22,500 volts. The entire line is divided into sections, and suitable measures have been taken to ensure an independent current supply to each of these sections so that in case of damage a section can be promptly cut out for repair without interference with the others.

At the generating station, which is situated at Chiapella, on the harbour side in Genoa, the first installation comprised two groups of three-phase steam turbo-alternators, each of 5,000 kw., 13,000 volts, 15 periods, each group being designed to carry an overload of 100 per cent. for five minutes. Space has been reserved for the installation of the third group above referred to. The work will soon be well in hand upon the construction of hydro-electric plants from which a supply of electricity will be obtained for operating these lines, and the Chiapella steam station will then be held in reserve as a standby.

Do Low Fares Increase Riding?

By M. Irwin Fullerton, District Auditor D. U. R.

For many years city street railway operators in the United States have been informed that a reduction in the rate of fare would not be detrimental to their interests because the increased riding would offset the reduction in the rate, or, in other words, that if the 5-cent fares were reduced to 3 cents there would be so much more riding on the cars that the gap in the gross receipts caused by the 2-cent reduction in fare would be closed. It is sufficient to say that the avenues through which this really marvelous theory of economics has been propounded have not been street railway operators or expert investigators. In the main, this argument has been advanced by organizations or individuals whose knowledge of electric railway matters has been, to treat it kindly, academic rather than practical. The absurdity of the premise as a general proposition will be apparent because if it were followed to its logical conclusion a 2-cent fare should be much more desirable than a 3-cent rate, and a 1-cent fare would be better than either.

Within the last six months the Detroit United Railway has had opportunity to observe the effect of a lower rate of fare upon the riding habit. Since August 15, 1913, under a temporary day-to-day agreement with the city, a seven-for-a-quarter rate has prevailed as the principal fare factor, as compared with a straight 5-cent fare previously. The difference in the rate will be generally acknowledged as sufficient to give a fair test of the theories of the low-fare advocates. What has been the result?

The following table shows the percentage of increase in passengers carried during the last thirteen months over the same months a year ago.

With 5-Cent Fare		With 7 for a Quarter Tickets	
Month	Per Cent Increase	Month	Per Cent Increase
January	20.53	†August	16.03
February	16.89	September	19.42
March	20.41	October	16.41
April	17.41	November	14.65
May	18.15	December	13.39
June	15.17	January, 1914	12.38
*July	9.53		

***July, 1912, traffic above normal. †Fifteen days in Aug. were under 5c. fares.**

It will be observed that in both January and March of 1913 the percentage of increase was greater than in September, the month which shows the largest percentage of increase in passengers of all since the low-fare agreement has been effective. The average increase for the last four months of 1913 under the lower fare was 15.91 per cent., as against an increase of 19.34 per cent. for the first quarter and 16.87 per cent. for the second quarter of 1913 under the 5-cent rate. It will also be observed that there has been a steady decrease in the percentage of increased passengers carried in each succeeding month since the low-fare arrangement, October dropping 3 per cent. under September, December 3 per cent. under October, and January, 1914, 1 per cent. under December.

With these statistics it is exceedingly difficult, in Detroit at least, to reconcile the theories of the low-fare advocates with the results obtained in actual practice. As a matter of fact, the conclusion is inevitable that the average rider on city railways uses the car because he wants to get to some particular place for business or pleasure. If there is any percentage of the public which uses the street car for pleasure-riding purpose or travels simply for the ride, it is imperceptible. If there has been any increase in the short-distance riders because of the lower rate, it certainly is not distinguishable.

It would seem evident that there are factors which affect the riding habit much more than the rate of fare. Industrial conditions and rapid or retarded growth in population should be regarded as the most important of these other factors.

There is a phase of the lower-fare more-riders theory which has been either overlooked or disregarded by its advocates, yet it is a phase which has a very important bearing upon the finances of a street railway. If it were true that increased riding followed fare reduction, it is unquestionable that increased transportation facilities must follow, with a consequent increase in cost of operation, and if the gap in receipts between two rates of fare could be equalized by a larger patronage at the lower fare, there must still be taken into account the larger drain upon the treasury caused by the cost of the increased service.

Whether it is really beneficial to the public to have lower fares is a broad question with plenty of arguments on both sides. But it must be recognized that if fares are reduced to such a point as to give a bare margin over operating expenses, street railway companies will not be able to provide the service which they could supply under more favorable fare conditions. Sometimes cheap rides are not economical for the public, and it is reasonable to believe that the individual rider will be better off in the end if he forgoes the small saving which he might make under a lower rate of fare and places the quality of service as the first consideration in his mind. So long as the product of the street railway company has a fixed price and its expenses work on a sliding scale with the trend continually upward, it is a mathematical certainty that the public cannot receive more than it pays for.—Electric Railway Journal.

"Safety First"

A small folder entitled Safety First is being distributed by the Toronto Railway Company among their employees. This folder is issued by the Ontario Safety League, which was organized in September, 1913, under the suggestion of the Ontario Railway & Municipal Board. A campaign was started early in the present year and since that time the association has spared no effort to educate the public into the full meaning of the words "Safety First." Local branches will be organized throughout the province which will be under the direction of the parent League with head office at Toronto. This is being accomplished by lectures, literature, blotters, circulars, warnings placed conspicuously on billboards, street car signs and through the newspapers. In addition to this a free moving picture show entitled "The Price of Thoughtlessness" is being given in Toronto for the benefit of the children.

The following is the text of a letter to the officers and employees of the Toronto Railway Company by the general manager, Mr. R. J. Fleming, which indicates the interest taken by this company in the "Safety First" movement,—

"You are no doubt aware of the fact that an association has been formed in the city of Toronto, having for its object the prevention of accidents and injuries to human life. This association is known as the Ontario Safety League and its formation is mainly due to the untiring efforts of Mr. Andrew Ingram, Vice-Chairman of the Ontario Railway & Municipal Board.

I am taking this method of informing you that it is the intention of our company to do all that it can to promote the welfare of the League in attaining its object as above mentioned. You will readily understand that this can best be accomplished by the hearty co-operation and personal effort of each one of us. I therefore strongly recommend that you join the league as soon as possible. It being my hearty desire that every employee of our company take a personal interest in this humanitarian movement."

Illumination

The Field of the Gas-Filled Mazda Lamp[*]

By Mr. S. H. Blake

The advent of a radically new illuminant into practical use always means that there must be a readjustment of established lighting practice in order to make room for the new-comer. Such a transition is now commencing, owing to the recent appearance of the wonderful gas-filled mazda lamp. It is interesting to consider briefly the prospective field and scope of this new light source in its present state of development.

It is very difficult to compare directly and to classify the various methods of producing artificial light, owing to the many varying factors that must be considered and weighed as to their relative importance. Furthermore, the particular qualities that make a certain light source well suited for some purpose make it entirely unsuitable for other equally important applications. The gas-filled mazda lamp, however, is strikingly attractive from almost every standpoint, as it embodies in one unit the desirable qualities of the incandescent lamp, namely, steadiness of light, constant color value, cleanliness in operation and low maintenance labor cost, etc., together with high efficiency and good quality of light when compared with the present standard practical arc lighting units.

Owing to the fact that the gas-filled mazda lamp in its present form gives its highest efficiencies when it is made for about twenty amperes, or more, the fact at once becomes apparent that this new lamp is highly suited for series connection. The only practical method of operating such high current lamps on direct current constant potential circuits will be to connect them in series-multiple, whereas for alternating current constant potential connection, they may be operated either in series-multiple or from individual or group step-down transformers or compensators. If the lamps are made suitable for direct, single connection across one hundred and ten volts a.c. or d.c constant potential, they will operate at a very appreciably lower efficiency than when made for high currents.

Even a casual consideration of the few essential characteristics mentioned will indicate that there are really two types of gas-filled mazda lamps with a well defined line of demarcation between them.

First, there is the real gas-filled mazda lamp, as we may call it, operating at high current and low voltage, the efficiency of which compares favorably with that of the magnetite arc lamp; and, second, there is the low current gas-filled mazda lamp which is practically an improved mazda lamp operating, to be sure, at attractive efficiency, but not, at the moment, in the same class with the high current lamp. In fact the only excuse for the low current type is that it can be operated on existing circuits without auxiliary devices, whereas the practical economical use of the high current lamp will involve the design and production of new apparatus and fixtures, as well as some changes in connections and practice.

For example, if it is desired to operate a 20 ampere gas-filled mazda lamp from a 110-volt constant potential circuit it will either be necessary to connect several of them in series, the number being dependent upon the candle-power of the lamps, or else if the circuit is alternating current a small transformer or compensator can be used to step the voltage down to the correct value for the lamp. Such a transformer or compensator should be preferably mounted with the lamp itself. The whole combination should have a cover or casing to give it a pleasing and finished appearance and to protect the lamp, socket and windings from weather conditions when used out-of-doors. Arrangements should also be provided for attaching suitable reflectors and provision should be made for a globe-holding device, as not only will diffusing globes sometimes be desirable but the hot glass bulb of the lamp should be properly protected from possible fracture due to rain, snow or sleet. It is also important that this whole structure be well ventilated so as to keep the interior parts as cool as possible. Thus, it is at once evident that special fixtures, etc., are necessary to properly use high current, gas-filled lamps in actual service. If it is desired to use the 20 ampere lamps on existing series street lighting circuits, it becomes at once apparent that either the street wiring suitable for 7.5 and 6.6 amperes will have to be replaced with heavier wire, to say nothing of the rewinding of current regulating devices; or else individual series transformers or compensators will have to be used, as with the multiple lamp, involving complete fixtures, etc.

The use of these transforming devices for running multiple and series gas-filled lamps will, of course, lower the operating efficiency of the lamps and also reduce the power-factor slightly; but the greater efficiency of the high current lamp makes it well worth while to use it in this way instead of using the low current lamp without transformers. This procedure is further influenced by the fact that the large, rugged filament of the high current lamp should be expected to give longer and more reliable service than the thinner filament of the low current lamp.

It is significant to note that even the low current gas-filled mazda lamp compares very favorably with the multiple arc lamp, particularly on d.c., as the ballast resistance necessary to make such arcs stable on constant potential greatly reduces the input watts per candle efficiency, whereas no such loss is necessary in operating the gas-filled mazda lamp. To a less degree the efficiency of the a.c. multiple arc lamp is lowered by the losses in the ballast reactance, but the power-factor of such lamps is about 30 per cent. lower than that of the gas-filled mazda lamp. In this field it is, therefore, probable that the gas-filled mazda lamp will become supreme except where conditions of severe vibration and rough handling make an incandescent lamp unsuitable, and in cases where the penetrating powers of the rays from the yellow flame lamp make it more effective.

For constant current connection the arc lamp is not handicapped to the same extent that it is for multiple operation, and before it can be predicted with any degree of accuracy just how far the gas-filled mazda lamp is liable to encroach into the field of series street lighting now practically dominated by the arc lamp, it will be necessary to determine by actual experience whether the gas-filled mazda lamp is inherently rugged and reliable enough to economically withstand the very trying conditions of this truly American method of operating street lamps.

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[*] General Electric Review.

The gas-filled mazda lamp will apparently meet European conditions better than it does ours in this country, owing to various causes. The practice in large cities abroad is to light the city proper with high candle-power units, generally arc lamps operating two or three in series on 110 volts or 4, 5 or 6 in series on 220 volts constant potential. These lamps are hung very high, quite close together and often are directly over the centre of the streets. High candle-power gas-filled mazda lamps should work out well under such conditions, as they throw a bountiful amount of light directly below the lamp. The steadiness of the gas-filled mazda lamp is another great point in its favor from the European standpoint, while its yellowish white quality of light will be much superior to the light of the yellow flame lamps that are now used there so extensively.

The perfect steadiness of the gas-filled mazda lamp will also be a very decided point in its favor in this country, particularly for the lighting of large interiors, doorways and in front of buildings. For street illumination it will be an interesting study to watch the progress it makes against the magnetite lamp, which is undoubtedly a remarkable lamp for street lighting due to its beautiful white color, its ideal light distribution, and its low cost of maintenance. The "life" of the gas-filled mazda lamp will largely determine its success in this field, for the cost of even one renewal will be a relatively large part of the yearly maintenance cost of one magnetite lamp.

As to flame, quartz, titanium and other high efficiency lamps the introduction of the gas-filled mazda lamp instead of tending to discourage their further development should greatly aid to still more perfect them. Even now the efficiencies that it is possible to obtain with some of these lamps are twice as good as the best that can be secured with the gas-filled mazda lamp. The general effect of the gas-filled mazda lamp on such other lamp developments will probably be to enhance the relative commercial importance of the qualities of steadiness and constancy of color values and to redouble the efforts already being made to obtain still higher efficiencies. These several qualities will be sought in arc lamps by using higher currents and smaller diameter electrodes.

It would be entirely premature at this time to try to analyze the probable cost of operation and maintenance of the gas-filled mazda lamp compared with other lamps for equal illumination of streets, but it is not unlikely that such a comparison would show that the titanium and flame lamps are the most economical, practical illuminants at high cost of power and the magnetite and gas-filled mazda lamps when the cost of power is low.

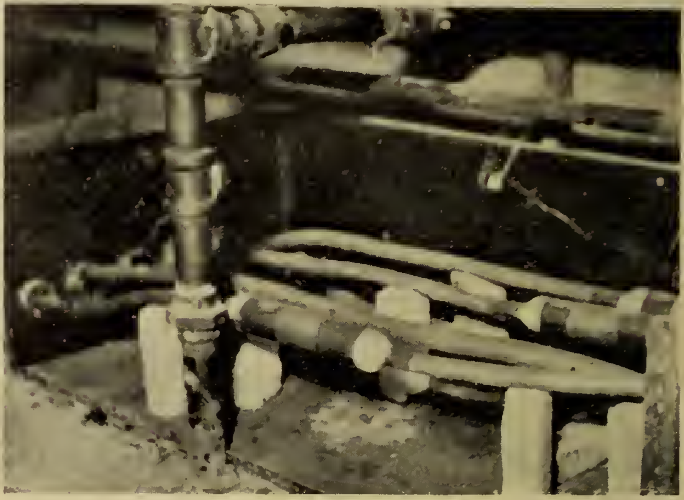
At a recent council meeting a proposal from United Colliery, Limited, controlling 6,000 acres of coal lands near Lake Wabamun, also the Cardiff Colliery of Morinville having an output at the present time of 600 tons daily, offered to supply the city of Edmonton with electrical energy at 3-5 of a cent per kw.h. plus a charge of $12.00 per year per horse power. This, if carried out would mean a saving of several thousand dollars in power bills as at present the power house is charging in the neighbourhood of 2 cents per kw.h. to the Light and Power Department also to the Street Railway Department.

Underground Feeder System—Manitoba Agricultural College, St. Vital

By Mr. R. L. Riggs

The Manitoba Agricultural College at St. Vital—eight miles from Winnipeg—opened in October, 1913. The contract for the underground electrical work was awarded to the Winnipeg Engineering Company, Limited, in September, 1913, and the installation was completed in December.

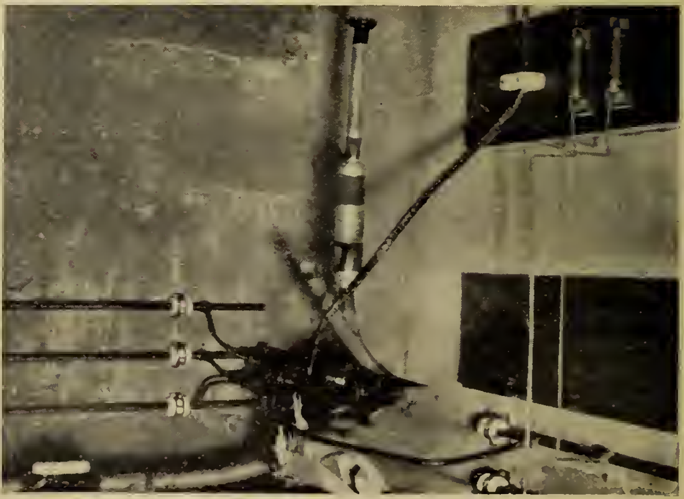
All the buildings at the college are wired on the three-wire system, single-phase 220/110 volts and all wires are encased in conduit. The buildings also have a 660 volt, power, d.c. service to operate the fans for the ventilating system.



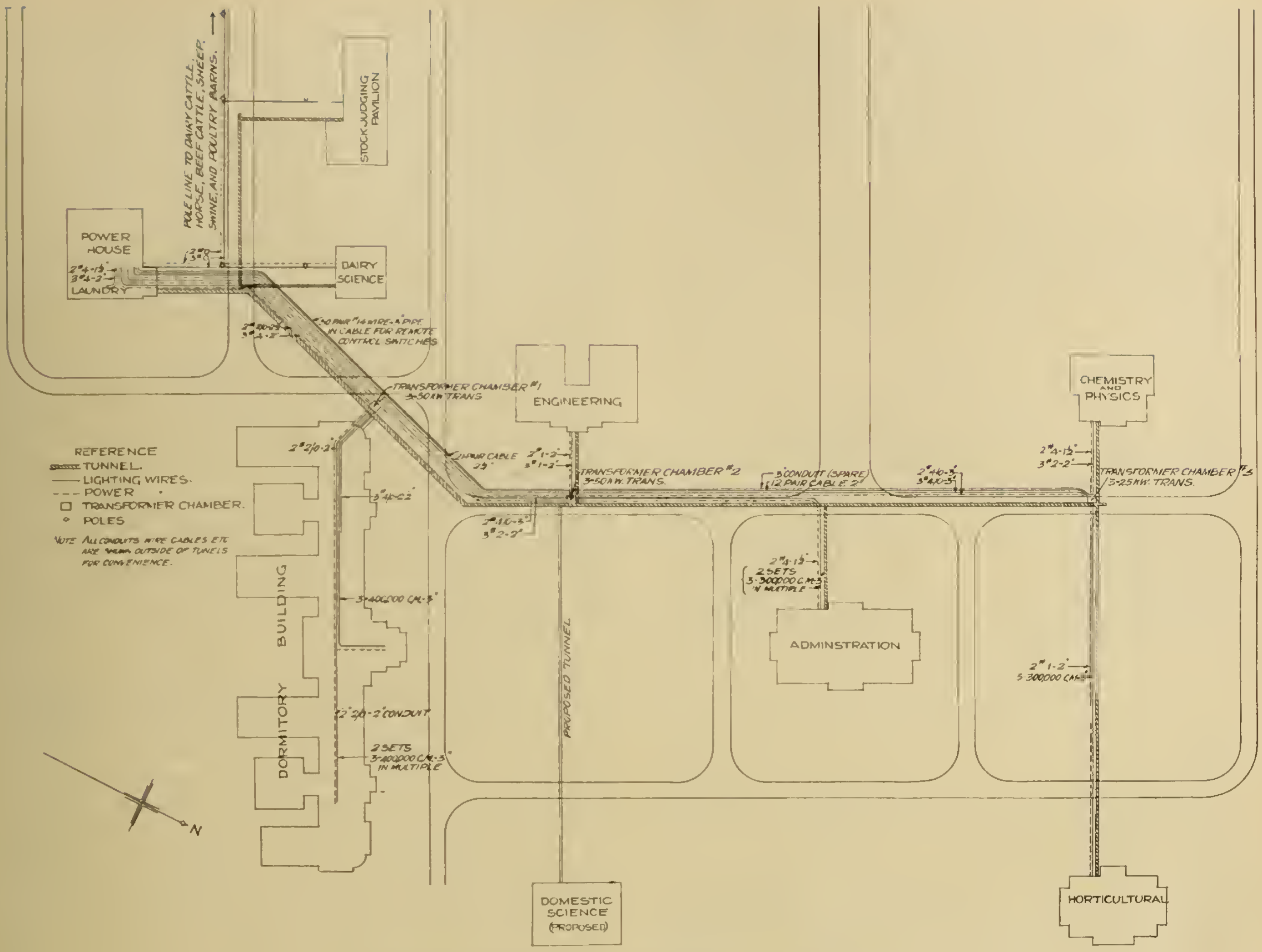
Junction box, showing cable joints.

The Provincial Government have signed a contract with the Winnipeg Electric Railway Company for a block of power and the company have built a three-phase transmission line, 22,000 volts, to serve the college and surrounding territory. There are three 600 kw. transformers installed in the high tension sub-station at the college which step the voltage down from 22,000 to 2,200. It is again stepped down at three transformer pockets, provided on the campus, to 220/110 volts before entering the buildings.

An underground tunnel system, built of reinforced concrete, connects the power house with the several buildings. In this tunnel all the high pressure heating mains, water mains, and the electrical feeder system are installed. The feeder cables are lead covered, paper insulated and are carried from the rear of the switchboard to the transformer



Transformer pocket—D.C. and A.C. bus structure.


POLE LINE TO DAIRY CATTLE, HORSE, BEEF CATTLE, SHEEP, SWINE, AND POULTRY BARNS.
STOCK JUDGING PAVILION
POWER HOUSE
2"4-1½"
3"4-2"
LAUNDRY
DAIRY SCIENCE
30 PAIR #14 WIRE-3" PIPE IN CABLE FOR REMOTE CONTROL SWITCHES
TRANSFORMER CHAMBER #1 3-50 KW TRANS
ENGINEERING
CHEMISTRY AND PHYSICS
REFERENCE
TUNNEL.
LIGHTING WIRES.
POWER
TRANSFORMER CHAMBER.
POLES
NOTE ALL CONDUITS WIRE CABLES ETC ARE SHOWN OUTSIDE OF TUNELS FOR CONVENIENCE.
2"2/0-2"
3"4/0-2"
21 PAIR CABLE 2½"
2"1-2"
3"1-2"
TRANSFORMER CHAMBER #2 3-50 KW. TRANS.
3" CONDUIT (SPARE) 12 PAIR CABLE 2"
2"4/0-3"
3"4/0-3"
2"4-1½"
3"2-2"
TRANSFORMER CHAMBER #3 3-25 KW. TRANS.
2"1/0-3"
3"2-2"
3-400,000 CM-3"
2"4-1½"
2 SETS 3-300,000 C.M.-3" IN MULTIPLE
ADMINSTRATION
BUILDING
DORMITORY
PROPOSED TUNNEL
2"2/0-2" CONDUIT
2 SETS 3-400,000 C.M.-3" IN MULTIPLE
2"1-2"
3-300,000 C.M.
N
DOMESTIC SCIENCE (PROPOSED)
HORTICULTURAL

Plan of buildings showing service wires, tunnels, transformers, pockets, etc.

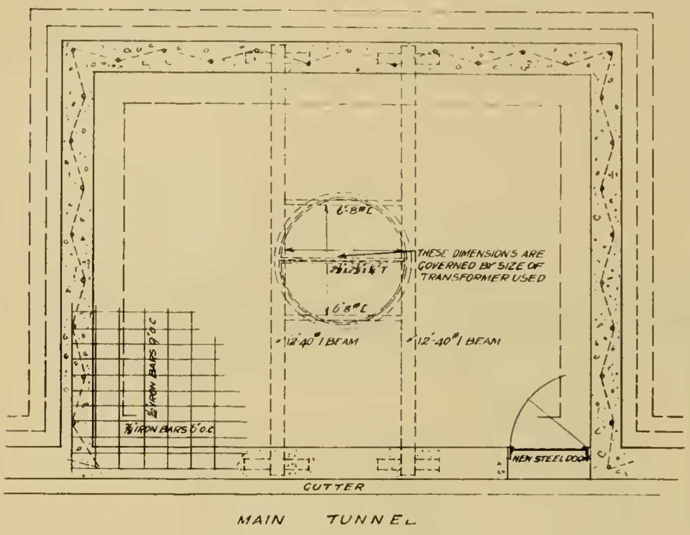
pockets. In transformer pockets No. 1 and 2 there are three 50 kw. single-phase 2,200/220/110 volt transformers, and in No. 3 pocket are three 25 kw. transformers.

Hartman oil switches electrically operated from the power house are provided for each transformer, so that in case of trouble occuring, any one of the buildings can be cut off the system. The pockets are 16 ft. x 12 ft. x 6 ft. 6 in. high and there is ample room provided for additional transformers. Each chamber has an iron door with a ventilator at the top and bottom.

Schedule of Cables

From	Service	Distance	Conduit	Voltage	Lead and Paper
Switchboard to Pocket No. 1	Lighting	410	2"	2200	3 cond. No. 4
Switchboard to Pocket No. 1	Power	410	2½"	600	2 cond. No. 2/0
Switchboard to Pocket No. 2	Lighting	711	2"	2200	3 cond. No. 2
Switchboard to Pocket No. 2	Power	711	3"	600	2 cond. No. 4/0
Switchboard to Pocket No. 3	Lighting	1290	3"	2200	3 cond. No. 4/0
Switchboard to Pocket No. 3	Power	1290	3"	600	2 cond. No. 4/0
Pocket No. 1 to Dormitory	Lighting	300	2½"	220	3 cond. No. 4/0
Pocket No. 1 to Dormitory	Lighting	700	3"	220	3 cond. No. 400000
Pocket No. 1 to Dormitory	Lighting	1000	3"	220	3 cond. No. 400000
Pocket No. 1 to Dormitory	Power	800	2"	600	2 cond. No. 2/0
Pocket No. 1 to Dormitory	Power	1000	2"	600	2 cond. No. 2/0
Pocket No. 2 to Engineering	Lighting	78	2"	220	3 cond. No. 1
Pocket No. 2 to Engineering	Power	78	2"	600	2 cond. No. 1
Pocket No. 2 to Administration	Lighting	425	3"	220	3 cond. No. 300000
Pocket No. 2 to Administration	Power	425	1½"	600	2 cond. No. 4
Pocket No. 3 to Chemistry	Lighting	86	2"	220	3 cond. No. 2
Pocket No. 3 to Chemistry	Power	86	1½"	600	2 cond. No. 4
Pocket No. 3 to Horticultural	Lighting	406	3"	220	3 cond. No. 300000
Pocket No. 3 to Horticultural	Power	406	2"	600	2 cond. No. 1
Control Cable to Pocket No. 1	Oil Sws.	410	3"	110	30 pair No. 141
Control Cable to Pocket No. 2	Oil Sws.	302	2½"	110	21 pair No. 141
Control Cable to Pocket No. 3	Oil Sws.	581	2"	110	12 pair No. 141

The high tension, copper tubing bus bars are mounted on the walls and are supported by clamp insulators manufactured for this purpose. All the connections are made with Dossert connectors. The low tension feeders are lead and paper cables carried in conduit to the entrance cabinets situated in each building. Pot-heads are used wherever the lead cables terminate. In the transformer chambers all the incoming and outgoing cables are also equipped with pot-heads.



One of the transformer pockets.

In magnitude this is one of the largest private underground systems in Canada, and the apparatus and fittings are of the latest manufacture.

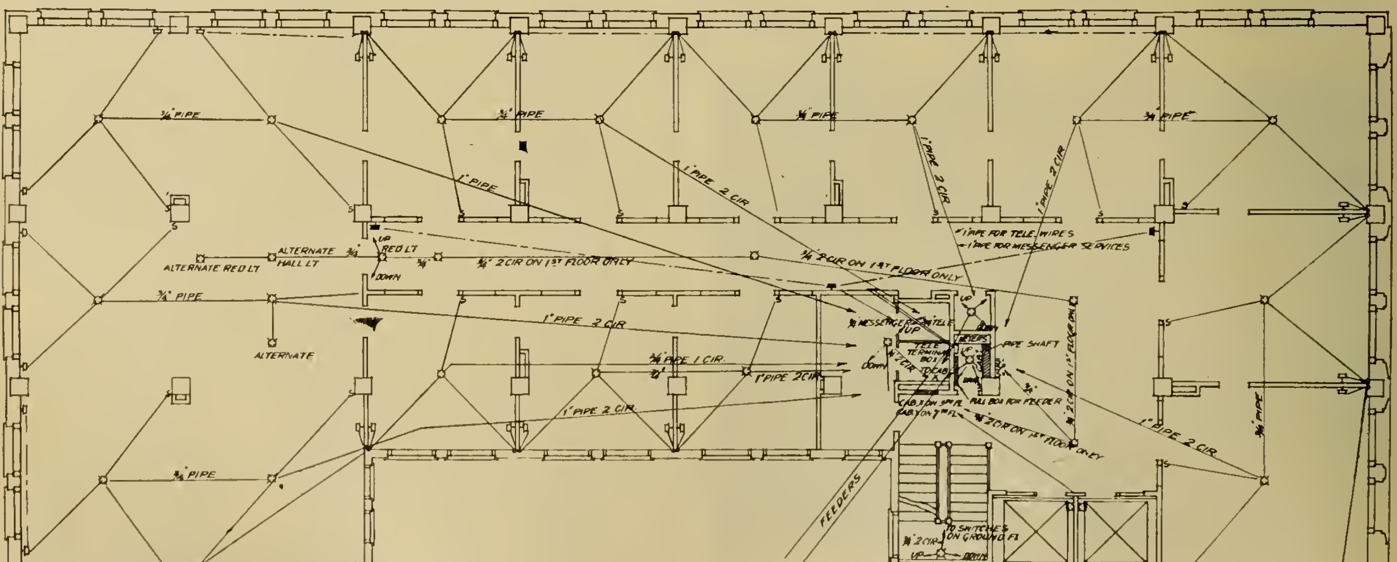
For the purpose of supplying light and power to the sheep, cattle barns, etc., a low tension pole line is built. The poles are cedar—45 foot long, 7 inch tops. The wires are No. 0 weatherproof triple braid. A complete list of cables used in the installation is given in the accompanying table.

The Electrical Equipment of the Yorkshire Building, Vancouver

The most recent example of modern office block construction in Vancouver is the ten-storey Yorkshire Building, an imposing Gothic structure, occupying a site measuring 50 x 120 feet on Seymour Street, near Pender Street, and fitted with electrical equipments of the most modern type. The Yorkshire Guarantee and Securities Corporation, Limited, and the Yorkshire Insurance Company, Limited, the joint owners of the building, occupy the entire ground floor which has been designed for conducting a general banking and trust business, and is treated architecturally in an impressive style conforming with the appearance of the exterior. With the exception of the 8th floor which is occupied by the American Club, the upper storeys are given over entirely to office space, there being eleven single offices and one suite, comprising five offices, on the typical floor. The building throughout is decorated in a most elaborate manner and may aptly be described as one of the most useful and attractive of its type in the province. One-half of the basement has been set apart as rental space while the other half is utilized for the heating plant, consisting of a Webster vacuum system, and the switchboard room.

The B. C. Electric Railway Company supply the light and power which is used in the building and consists of 500 volts d.c., and 220 volts, 3-phase, and 220 and 110 volts single-phase. The 220 and 110 single-phase are used for lighting purposes, while the power supply is being taken care of by the 220 volt, 3-phase exclusive of the current required for two Otis Fensom elevators of one to one traction type which are operated by 500 volts d.c.

The wires for the lighting service consist of three 600,000 c.m. cable and the power service is two 300,000 c.m. cable, the three-phase being made up of three No. 4/0 cable. The switchboard which controls both services was manufactured by A. R. Coutts & Company, Vancouver, and is 6 feet wide and 7 feet in height, with one lighting panel and one power panel of blue Italian marble. All conduits terminate in a steel pull box set in a concrete slab and flush with the ceiling in the basement. From this pull box the wires are carried to the various switches on the board in three steel raceways with removable sides, thus permitting access to any pair of wires at all times. From each of these raceways a conduit is taken to the rear wall on which is mounted four meters, one for the 500 d.c. one for the halls, toilets and public spaces and one for the banking and trust quarters on the ground floor. The method of wiring the various offices on the upper floors provides a circuit to each office, and every circuit is run to a metering panel. The metering panels are set in a closet, specially designed for the electrical equipment, and consist of a slate slab with buzzing



Typical floor plan of Yorkshire Building, Vancouver.

switches and cut outs so arranged that any circuit or combination of circuits on the same floor may be connected on that floor without changing or adding to the original wiring system. The apparatus is arranged in a manner which eliminates the danger of short-circuiting any part of it through mistakes in making connection. The flexibility of the metering system is demonstrated by the fact that any of the different offices may be put on any meter or any number of offices put on the same meter. Provision is made for mounting the meters in a steel cabinet, everything being left in readiness even to the screws which hold each meter in place ready for the wires to be inserted into the conduit terminals. Absolutely no wood is used in the construction of these cabinets.

The cabinet in the Yorkshire Company's offices on the ground floor consists of a double panel of 18 circuits each with flush push switches in the trim. The front of this cabinet is of ⅜-in. cold rolled steel and electroplated in old bronze. The switches on the trim control the massive electroliers of Gothic design in the ceiling of the banking offices.

Every office in the building contains one 3-light ceiling fixture and two wall plugs. The centre lights in each office are controlled by an H. and H. switch with special switch plates to match the trim of the door in which they are placed at a height of 4 feet from the ground. The wall receptacles are of the Bryant screw plug flush type with No. 1709 plates, and all fittings are of bar buff finish except in the Yorkshire Company's own offices where statuary bronze has been used as finish. All the wire used in the building was supplied by the Canadian General Electric Company.

The telephone system consists of a service of 200 pair cable redistributed in the basement and on the 3rd and 7th floors, allowing 15 pairs for each floor. The system is so arranged that one-half of every floor communicates direct with the headquarters of the telephone company while the other half runs to a cross connecting strip box in the basement to permit of the interconnection of telephones throughout.

The electrical equipments of this building were installed by NePage, McKenny & Company, the largest firm of electrical engineers and contractors on the Pacific Coast, under the supervision of Mr. E. G. Mundy the company's local manager.

The Yorkshire Building was erected at a total outlay of approximately $300,000 by the Dominion Construction Company, Vancouver, who completed the general contract at the beginning of March, 1914. Messrs. Somervel & Putnam, Vancouver, were the architects.

The Wahnapitae Power Company, Limited

The Wahnapitae Power Company was organized in 1905 to develop power on the Wahnapitae River, which rises in the Temagami Forest Reserve and empties into the French River. Two power plants were constructed near Sudbury and put in operation with two units each, and it has now been arranged to install a third unit at No. 1 plant to supply the demands for power being made upon the company. This new unit will increase the company's power output by about 50 per cent. In the drainage area contributory to the Wahnapitae River, affording storage facilities, are Wahnapitae Lake, approximately 36 square miles in area, and Welcome Lake, Burwash Lake and Long Lake with an area of approximately 15 square miles.

Plant No. 1 is about 10 miles from Sudbury and has a working head of 52 feet. The machinery consists of one 1250 kw., 2300 volt, 300 r.p.m. C.G.E. alternating generator; one 800 kw., 2300 volt, 300 r.p.m. C.G.E. generator; two exciters direct connected to turbines; one 1800 h.p. Jenckes turbine; one 1550 h.p. Jenckes turbine. The power house is a substantial masonry building with concrete floor and switchboard gallery. Adjoining the power house is a transformer house in which are located the transformers belonging to the Mond Nickel Company and the Moose Mountain Company. Transformers for the current which the Wahnapitae Power Company transmits to Sudbury are also located in this power house. A dwelling for the operators is located on the premises. It is now arranged to add a third unit of 2000 kw. with necessary turbines, switchboard, etc.

Plant No. 2 is situated about 16 miles below plant No. 1 and has a working head of 38 feet. The machinery consists of two 1250 kw., 2300 volt, 257 r.p.m. C.G.E. generators direct connected to two 1800 h.p. Kennedy turbines, and one exciter also direct connected to a turbine. The power house is of concrete construction, 60 x 80 feet, with concrete gallery for lightning arresters and high tension switches, and contains transformers owned by the company for stepping up current for transmission to No. 1 plant, and transformers belonging to the Canadian Exploration Company used for stepping up power purchased by them for transmission to their gold mine 15 miles distant.

The switchboard apparatus in both stations is up-to-date, and all generators are controlled by automatic oil switches. The exciters are fitted with Tirrill regulators and the voltage regulation is excellent, even under very great variation of load. The stations are well kept and the machinery has all been well cared for and is in excellent condition. The only combustible part in either power house is the wood in the roof.

The company sells power wholesale at the power house under contract to the Mond Nickel Company, Limited, the Moose Mountain, Limited, the Dominion Nickel Company, Limited, and the Canadian Exploration Company, Limited, and transmits power at 22,500 volts over its own transmission line 10 miles to its sub-station in the town of Sudbury, Ont., population about 6,500. At Sudbury the company sells current to the municipal corporation for lighting purposes, and also sells power direct to the consumer on its own account, and for this it owns about four miles of distribution lines, 2200 volt two-phase in the town. Existing power contracts amount to 4,468 horse power, and with the proposed extensions it would be possible to sell from 2,000 to 2,500 h.p. over and above the present load and still leave ample margin for good regulation. The present power output is approximately 3,800 horse power. The Mond Nickel Company will take an additional 1,000 h.p. as soon as the company can deliver it, and the power demand in the town of Sudbury is steadily increasing. It is well known that there is no more permanent mining than that of nickel, and the nickel areas of the Sudbury district, in which district the companies taking power from the Wahnapitae Power Company have their properties, are authoritatively stated to be well nigh inexhaustible. It is also well known that the Sudbury district is now producing about 70 per cent. of the world's supply of nickel.

The prices at which the Wahnapitae Power Company is selling power are very much less than power can be produced by steam, as the freight rate on steam coal from Suspension Bridge to Sudbury is $2.60 per ton, making the cost of coal between $5.00 and $6.00 per ton at Sudbury. Prices for power are based upon $14.00 to $16.00 per horse power at the switchboard in the power house (equivalent to about ¼ cent. per kw. hour with a 100 per cent. load factor. The Wahnapitae Power Power Company holds long term leases from the Ontario Government of its water powers on the Wahnapitae River. Both these leases are renewable upon the same terms that they are now held, the rentals being about $1,000 per year each.

The Dealer and Contractor

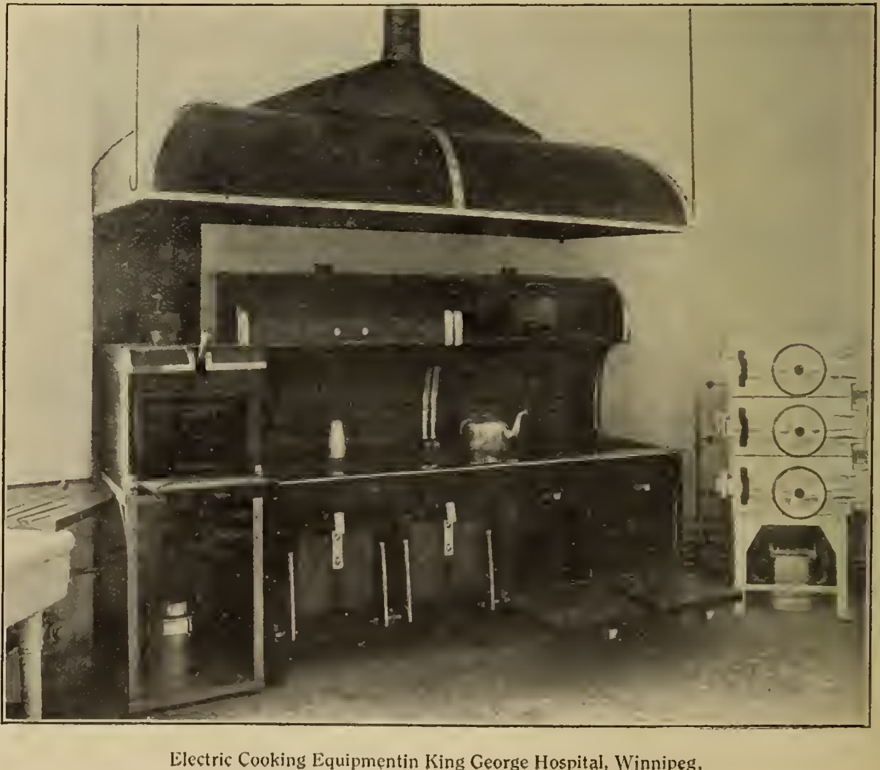
Steady Advance of Electric Cooking

Electric cooking apparatus for hotels and restaurants, although employed for the past few years in Europe, and particularly in England, has only recently received favorable consideration on this side of the water. It has, however, now become apparent to all who have looked into the question that for many cooking operations this method has numerous advantages over the use of coal or gas. And progressive chefs and their managers—if they expect to be truly up-to-date—cannot afford to overlook or ignore the issues raised by the perfection of electric cooking apparatus. Electric apparatus is particularly well adapted to high temperature operations such as broiling, frying, roasting, baking, etc., all of which are accomplished rapidly and with more ease and comfort than is possible with the old methods. Considerable floor space can also be saved by its installation. The problem of storing and handling coal is eliminated, as well as such objectionable features as smoke, gas and excess heat.

A recent large installation of much interest has been made by the Canadian General Electric Company for the King George Hospital, Winnipeg, as shown in this illustration, and a short description of the equipment will be of general interest.

The installation consists of two electric range units and one broiling unit and has sufficient capacity to take care of 250 persons. Each range section comprises two roasting ovens and a top cooking surface divided into eight rectangular hot plates. The overall dimensions of one section of the range are, 44-in. wide, 38-in. deep, 68-in. high (to top of switch box). The cooking surface is 33-in. above the floor. Each of the two roasting ovens in one section of the range is 18-in. wide, 28-in. deep and 16-in. high inside diameter. Each oven is arranged for two heats, the top and bottom units being separately controlled. The maximum consumption for each over is 4,800 watts.

The top cooking surface of one section of the range is 36-in. wide x 24-in. deep and consists of eight rectangular hot plates, each 9-in. x 12-in. These hot plates are controlled by separate switches, the four in front consuming 1,600 watts each, and the four in the back 800 watts each. The object of this arrangement of heat for the hot plates is to conform with conditions obtained on the coal burning hotel range. The four plates in front operate at a high temperature, and the kettles are first placed on these high temperature plates and brought to the proper cooking temperature. The kettles are then pushed back to the plates in the rear, which consume just one-half of the energy but will maintain the desired cooking temperature as long as required. This gives a very simple arrangement, but will amply provide for all requirements, and, as stated above, conforms with the conditions on a coal range, in which case one end is maintained at higher temperature and the other end at a lower temperature.



Electric Cooking Equipmentin King George Hospital, Winnipeg.

The controlling switches, as used on this range, are lever knife switches and are mounted on a slate panel above and at the back of the range. This panel is enclosed by means of a roll top door. The control switches are arranged in one row and a nameplate is placed over each switch to show what part of the range is controlled by that switch. A circuit breaker is mounted in the center of the panel and controls the main circuit of the range. In addition to this there are small cartridge fuses on the oven and hot plate circuits.

The walls of the ovens are all double and filled with navy fire felt, an insulating compound which will always retain its shape because it is moulded. The front of the range is of heavy steel plate. The ends of the range are of blued steel, and the back is of heavy galvanized iron. All the interior walls are of sheet steel.

An important feature of this range is that the hot plates on top are mounted in pairs on a casting which is hinged at the back. Each pair consists of one front and one rear hot plate. The entire space beneath the eight hot plates is taken up by one large scavenger pan. Thus the hot plates can be raised up in pairs and the scavenger pan below thoroughly cleaned out. This construction permits keeping the range in perfectly sanitary condition at all times.

The hotel broiler, as supplied with this range equipment has overall dimensions 23-in. wide, 41-in. deep. The active broiling area is 14-in. x 20-in. or 280 sq. inches, and is sufficient for broiling at one time about 12 lbs. of steak or chops having a thickness of 1½-in. If the weight of the average steak be taken as two pounds, the hotel broiler may be considered as having a capacity of five or six steaks at once, and as ten minutes is required for broiling, it is possible to broil about 36 steaks, or 70 pounds of meat per hour.

The radiant heating unit is located at the top of the broiler chamber and is controlled by a DP spring knife switch mounted on the back of the broiler but operated from the front. The unit is divided into two windings; the main winding consumes 4,500 watts and is used only when actually broiling; the auxiliary winding consumes 500 watts and is used for keeping the broiler hot between broiling operations. The gridiron, on which the meats rest, is supported below the unit on a movable frame, raised or lowered by a lever. The gridiron can also be drawn out for turning or removing the meats. A drip pan rests on the bottom of the broiler chamber.

Electrical Apparatus Co., Limited

One of the few modern electrical manufacturing firms which has works situated almost in the heart of London, Eng., is the Electrical Apparatus Company, Limited. This progressive company's manufactures comprise mainly motor control and switchgear and house service meters, of which latter they have just introduced a new type for a.c. services. The company commenced its career in 1907, its object being to supply gear of the above order which should be in advance of that then generally used, while at the same time, by the application of experience gained by the directors in America and the Continent as well as in England, the cost should be kept at a low figure. The premises in which manufacture was commenced soon had to be enlarged, and later, further extensions being impracticable, a new works was erected in Vauxhall on part of a site purchased by the company. This building was of a modern design, the works and offices all being on one floor, but within two years, the business had again outgrown its accommodation, and a floor was added to the offices, and a two-storey building was erected on the remainder of the site.

That the company was justified in its foundation is proved by the fact that although the volume of business which necessitated these expansions had to be obtained at competitive prices, the standardization of apparatus manufactured rendered it possible to make a substantial profit each year, and the financial expansion of the company has kept pace with the industrial, for twice within the last year extension of capital has been deemed advisable—at the latest of these in July, 1913, a new company—the Electrical Apparatus Company, Limited, was formed, the capital being raised from £30,000 to £90,000.

The company's apparatus is well known throughout Great Britain, and is steadily gaining a reputation in the colonies, especially in Canada, to which a considerable quantity is already exported. Not content with this, however, the company, which is already represented in every part of England, has decided to open a Canadian branch office in Toronto in the course of the next few months, in the hope that they may help to swell the volume of trade between the two countries, and to obtain their share in the expansion of Canadian electrical business.

The greater part of the gear manufactured is of more or less standard design, but there are many useful and ingenious improvements. The illustration, Fig. 1, shows what is possibly one of the neatest of these—the slow-motion attachment to the one minute type starters. The slow-motion is attained by a pawl carried on the lever, moving in a guideway provided with alternate camming and arresting shoulders. By this means a swift movement from one contact to another is obtained, while a definite stop on the centre of such contact is assured. The backward motion of the arm is not in any way impeded, and even the least skilled and most careless operator can hardly fail to obtain a satisfactory start. This same device is employed in the star-delta and auto-transformer starters to prevent the operator passing from the "off" to the running positions without resting at the starting position.

It is of interest to note that these starters are one of the few types made in England which are in accordance with Canadian regulations. All the oil-immersed switchgear is of the drum type, of extremely solid construction, and a patent self-aligning finger which is shown, ensures that perfect contact is made by each finger. In addition to this, the drum is turned up in the lathe, and the fingers, after being assembled, are ground to shape by a drum of the correct size covered with emery cloth. It is to the extreme care taken in these small details that the high reputation which the company enjoys is due.

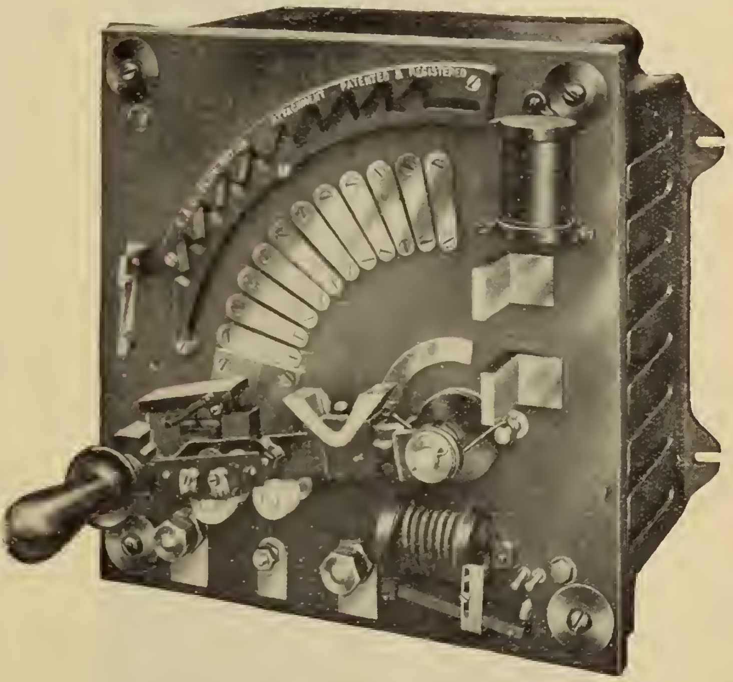


Fig. 1

Of a number of interesting designs, one of the most unusual is the Multiple Lever Automatic Starter, Fig. 2. As can be seen from the illustration this is a very simple piece of apparatus. There is only one solenoid, which pulls up a horizontal bar extending across the width of the starter against a dash pot. Each step on the starter is provided with a separate knife switch, each switch being raised slightly above the last. In this way the bar engages with each blade in succession, closing it slowly until the two springs with which each blade is provided come into operation and close the switch with a decisive snap.

A point of interest in the a.c. gear is the no-volt release, of which the magnet core consists of a heavy piece of laminated iron, detached from the lever which catches with the switch handle. In this way a decisive blow to the lever is assured from the impact of several ounces of iron falling through nearly ¼ inch—and the operation is certain. It is also worth noting that the motion of the lever in the squirrel cage motor starters is continuous in one direction, a much more satisfactory arrangement than the reversal of direction so common in these starters.

To turn to meters, the B.A.C. high torque continuous current meter is already well known. It is an ampere-hour commutator meter particularly adapted for use with small consumers, for owing to the high torque provided, reliable and accurate readings are obtained even with only one lamp in circuit. Both the commutator and the brushes are 18 carat gold, and oxidation or other alteration of the commutator surface is eliminated, while the insulation throughout is of mica with the exception of an ebonite sleeve under the commutator segments.

The a.c. meter, which has recently been designed, has, like the d.c. meter, a very high torque—9 cm.gr.—while the shunt losses are exceptionally low. For instance, tests show a variation of less than 2½ per cent. in accuracy between 25 and 50 cycles, and between 100 and 200 volts. Not only is this meter carefully designed from the point of view of accuracy but details of mechanical construction have had careful attention. For instance, by the removal of four easily accessible screws, the whole of the moving element and dials are removed, and can be attended to, at the same time leaving the coils and the magnetic circuits exposed for attention. By replacing the moving element upside down relative to the case, and securing with the same four screws in the same position, the meter can be used as for top terminal instead of for bottom terminal connection.

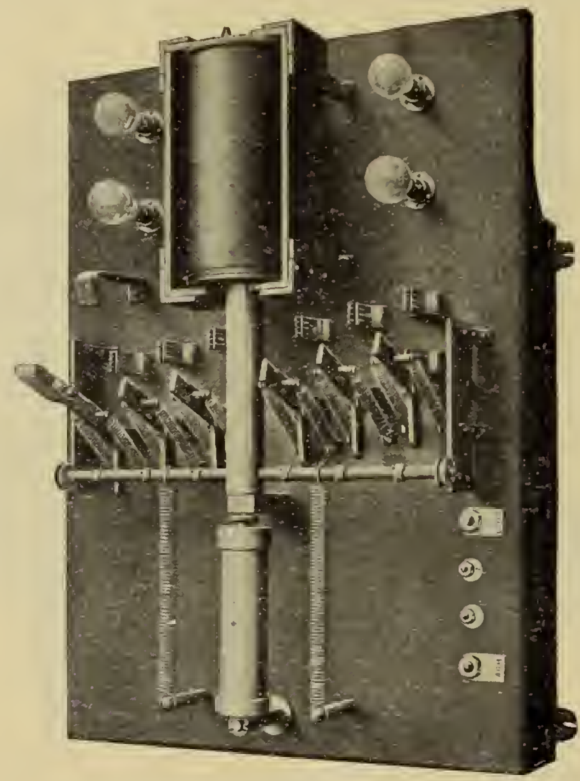


Fig. 2

All of the gear and meters manufactured are very carefully and thoroughly tested both during manufacture and on completion, and so far as is practicable, everything is made on the works, even to the cutting of the gear wheels on the meters.

Mr. Howard Murray, vice-president of the Shawinigan Water and Power Company, has promised to provide for a number of years two McGill scholarships in history of $100 each, to be awarded on the same conditions as the MacKenzie scholarships in economics.

A New Electrolytic Lightning Arrester

For the protection of cable systems, motors and generators connected directly on a line without transformers, or transformers with weak insulation on their end turns, the Westinghouse Electric & Manufacturing Company has recently introduced a lightning arrester, known as the Type AK, with a charge-and-discharge resistor in series with the standard electrolytic element. This resistor serves to limit the charging current to a low value and to damp out any surges that might result in charging, particularly if the system contains enough capacity to produce resonance. The arrester is made for use on circuits up to 14,500 volts.

The electrolytic element consists of treated aluminium trays stacked one on another, separated and insulated from each other by porcelain spacers on the periphery of the trays; the number of trays in a stack depending upon the normal voltage of the line on which the arrester is to be used. The stacks of trays are suitably supported in frames, and each tray is filled with electrolyte. The stacks are then arranged in welded steel tanks and immersed in oil.

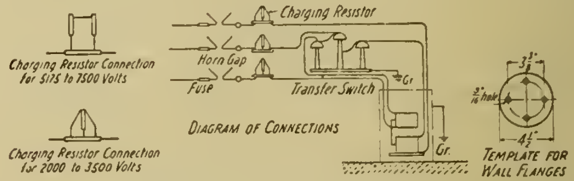
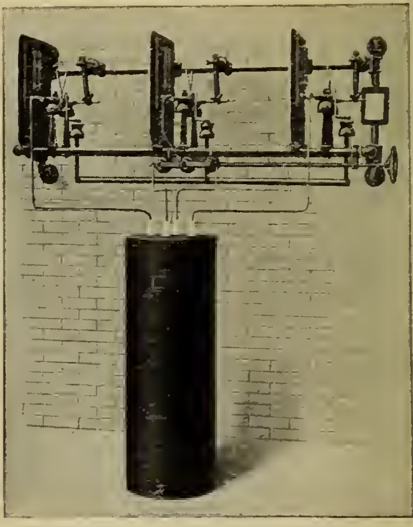

Charging Resistor Connection for 5175 to 7500 Volts
Charging Resistor Connection for 2000 to 3500 Volts
Charging Resistor
Horn Gap
Fuse
Transfer Switch
Gr
DIAGRAM OF CONNECTIONS
Gr.
3½"
⁵⁄₁₆" hole
4½"
TEMPLATE FOR WALL FLANGES

Diagram of connections, new arrester.

In actual operation, a film of the electrolyte forms on the surface of each tray. This film has a high resistance at normal voltages, but the resistance becomes very low at abnormal voltages. It therefore forms a free path for abnormal voltages or static charges, but upon cessation of the abnormal stress the film instantly regains its high resistance.

The arrangement of the trays and the electrolyte is such that the electrolytic element acts as an electrostatic condenser. The flow of current, due to the capacity of this condenser, varies inversely as the frequency of the circuit. Thus, at normal commercial frequencies, the flow of current is small, but at the high frequencies of lightning discharges and static disturbances, considerable current flows through the element, increasing the action of discharging the static charges and preventing flow of current at normal frequency.



New type lightning arrester.

When an electrolytic arrester is being charged, surging currents are set up in the system. Under most conditions these are harmless, due to insulation of the apparatus connected in the same circuit. However, as above noted, there are cases in which these surges are dangerous and in order to remedy this danger the graphite resistor is used to damp out the surges and limit the charging current to a low and safe value.

This resistor is connected in series between the horn gap and the arrester in each phase. It is shunted, however, by a series of non-arcing metal spark gaps which are auxiliary to the main horn gap. In the operation of charging the horn gap is short-circuited, as usual, and at the normal voltage of the circuit the charging account takes the resistance path rather than the shunt auxiliary gap path. On the occasion of a discharge due to lightning or static disturbances the auxiliary spark gap path is easily broken down, and the discharge passes through same rather than through the resistor, thereby assuring precisely the same freedom of discharge as in the case of an arrester which does not use the charging resistor. Upon the circuit being restored to normal voltage and frequency after the discharge the auxiliary spark gaps cannot maintain the circuit and it is shunted to the resistance path. This action is very materially helped by the use of multiple gaps between non-arcing metal. The resistor limits the amount of dynamic current flowing, and thus helps in the final action of opening the circuit by the rise and final break of the arc on the horn gap.

On each occasion of charging ungrounded neutral arresters to rebuild these films, after once bridging the horn gaps, the leads connecting the two middle legs to the ground and to the center fuse, respectively, should be interchanged and the gaps again bridged; thus serving to charge all the "legs" of the arrester. To facilitate this charge, a transfer switch is provided as shown in the illustration. A handwheel is geared to this transfer switch in such a way that the switch can be reversed without the operator in any way coming in contact with live parts, the frame of the arrester being grounded.

Multi-Circuit Totalizing Graphic Recorder

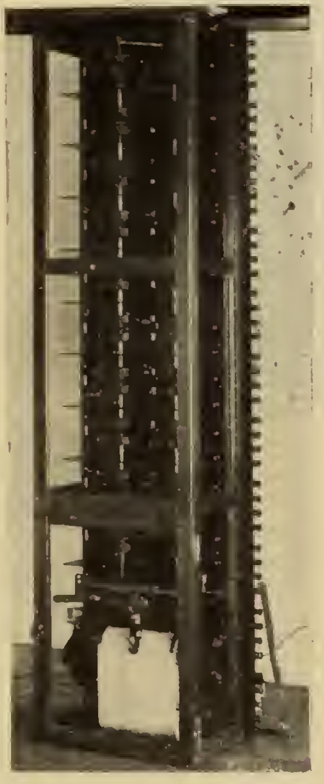
The accompanying photograph shows an eleven element Graphic Totalizer, which is probably the largest electrical graphic recorder ever built, not, perhaps, in point of size, but in capacity. This meter was built for 110,000 kilowatt service, full scale reading, and is to totalize the wattage of eleven separate polyphase circuits simultaneously.

These meters act on the principle of the true Kelvin balance: namely, the balancing of an electrical force against a travelling weight on a scale beam, and not against some form of spring, as in most other types of Graphic Recorders. The travelling weight is moved along its ways by means of a drag link attached to the control system, which operates the pen mechanism. The control system consists of two solenoids with plungers attached to control the arm, which in turn, moves the pen along its ways. These solenoids are energized through contacts carried on one end of the measuring element, but in no way interconnected with the measuring system. Thus, a source of power is supplied from a separate circuit to move the pen and weight without in any way affecting the measuring element.

From the bottom measuring element downwards, the mechanism is simply that of a standard meter, with the exception of two small steel cups located in the balancing element, in the center of the potential coil. Standing in these cups on steel points are two brass rods which run vertically the full length of the meter, and carry the potential coils of each measuring element. Thus the forces of each and every measuring element which is alive, are communicated directly to the bottom measuring element, and scale beam, where their sum is weighed by the gravity system. The upper ends carry small steel cups and the bed plate to the rear of each rod has two stationary cups. Two triangular brass plates with steel points at each corner are then placed so that two points rest in the bed plate cups and one in the cup on the top of the rod. This provides a perfectly frictionless support for the top of the rods and allows them to move up and down when the element is balancing. As this is a zero reading instrument, this balancing motion is not over 1/100 of an inch.

The elements are astatically wound to eliminate the effect of stray fields and heavy iron baffle plates are placed between elements which completely eliminates the magnetic effect of one element or another.

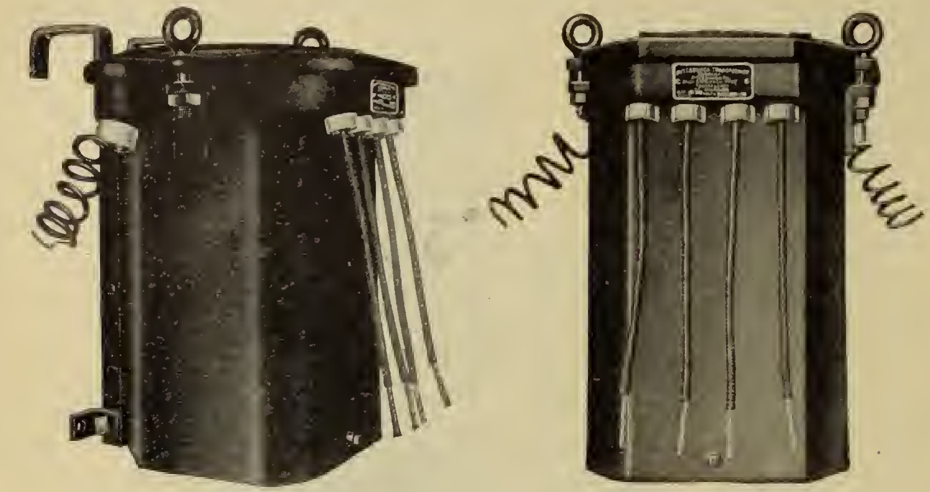
The sensitiveness of these meters is equal to, if not superior to that of any graphic meter we know, the extreme weight of the measuring element in no way impairing its sensitiveness. These meters are so accurate that they can be guaranteed to within one-half of one per cent., full scale reading at all points of the scale. On test, they have always shown themselves accurate to within one-tenth of one per cent., and, due to the gravity principle, the scale is always perfectly proportional. This metre is manufactured by Staebler & Baker, Gananoque, Ont.


Multi-circuit Totalizing Graphic Recorder.

Pressed Steel Transformer Case

A new and radically different type of transformer case for distributing transformers has been developed, illustrations of which are herewith shown. This new case is of pressed-steel, replacing the ordinary cast-iron cases which have been in general use for the past twenty-five years. The material used is blue-annealed planished steel plate. The principal advance in design claimed for the new pressed-steel case is, that it is much lighter and stronger than the ordinary cast-iron cases. The reduction in weight of transformers is important to the Central Station, because the cost of handling transformers is a definite appreciable item of expense to which little attention has been paid heretofore, probably because there was no escape from the bulk and weight of distributing transformers, since all manufacturers have been confined to the use of heavy cast-iron cases.

Transformers are really a tonnage material when considering the handling expense, the lightest and smallest size weighing at least 100 lbs., and the medium and larger sizes weighing up to 3,000 lbs. each, for the pole type sizes. The handling of distributing transformers is necessarily done by the line-crew with "hand-power" and "man-power," which is higher in cost than "horse-power." Saving in the cost of freight is easily seen because it can be definitely shown by figures. An average saving to the total transformer weight of 30 per cent. claimed by the manufacturers of the new pressed-steel case transformers, means practically an average saving of 30 per cent. in freight. While it is difficult to get accurate Central Station costs for the handling of such heavy material as transformers, fairly close estimates are made and such estimates show that on 10,000 lbs. of transformers shipped 500 miles, the freight, cartage, loading, unloading, warehousing, installing, etc., costs about $110. Thus, a 30 per cent. decrease in weight saves $33.



Light weight pressed steel transformer cases.

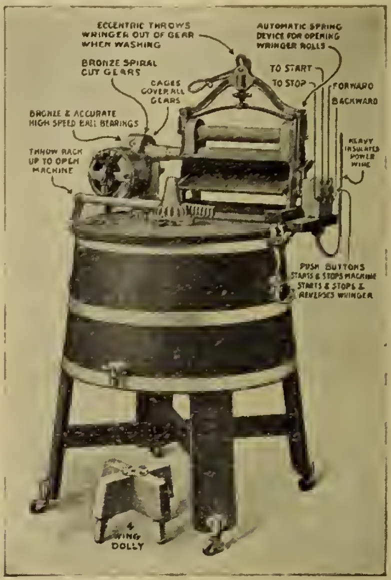
The percentage of weight reduction (30 per cent.) is substantial enough to result in other practical benefits to the Central Station in permitting larger transformers to be mounted on poles with the same pole-strain safety factor, or permits the use of smaller poles for given transformer sizes. Reduction in weight with the additional advantage of strength is, of course, very desirable. It is claimed that the new pressed-steel case has been developed not only lighter in weight, but much stronger than cast-iron, so that the new case will stand up even better to the every day wear and tear, rough handling in transit, accidental bumps and jars, such as sometimes hapepns when a transformer is dropped from a pole or wagon.

Tests were made by a prominent laboratory, it is stated, where thirteen blows with a sledge failed to show any injury, except slight indentation of the pressed-steel, whereas, two blows of the sledge applied to an ordinary cast-iron case cracked the cast-iron case with the first blow and completely shattered it with the second blow. The common cast-iron case will leak oil, due to seepage through the porous cast-iron unless it is carefully Japaned, and where the cast-iron is imperfect or thin, hot transformer oil will seep through the metal and drip. Pressed-steel, due to its density, and non-porous structure, eliminates the possibility of oil seepage. The new pressed-steel case has been under development for several years and it is stated actual tests in service have been thoroughly carried out by its originators, the Pittsburgh Transformer Company, Pittsburgh, Pa.

The town of Leduc have asked a local firm of consulting engineers to proceed with the plans and specifications for a municipal electric light plant, when the necessary by-laws will be submitted for the approval of the ratepayers.

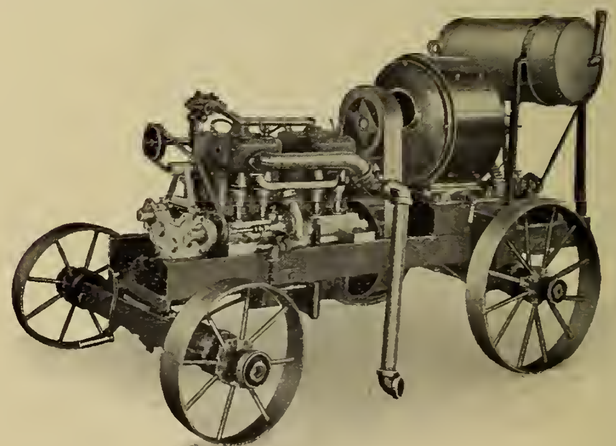
The "Electric Lady" Washer

The "Electric Lady" washer is a new machine which is just being placed on the market by the Michigan Washing Machine Company, Muskegon, Mich. This machine has been carefully designed to include the very latest electrical and mechanical features; for example, the whole machine is controlled by push buttons. All moving parts are fully protected and an automatic electric wringer release insures absolute safety to the operator's hands. Ball bearings are used where the greatest strain occurs and bronze bearings in other places. As quiet operation was considered essential, all moving parts are carefully designed to run quietly and the materials are so selected that the wear is small. Adjustment is also provided for wear. A Westinghouse Electric small motor furnishes the power.


ECCENTRIC THROWS WRINGER OUT OF GEAR WHEN WASHING
AUTOMATIC SPRING DEVICE FOR OPENING WRINGER ROLLS
BRONZE SPIRAL CUT GEARS
TO START
TO STOP
FORWARD
BACKWARD
CAGES COVER ALL GEARS
BRONZE & ACCURATE HIGH SPEED BALL BEARINGS
THROW RACK UP TO OPEN MACHINE
HEAVY INSULATED POWER WIRE
PUSH BUTTONS STARTS & STOPS MACHINE STARTS & STOPS & REVERSES WRINGER
4 WING DOLLY

Illuminating Amusement Devices

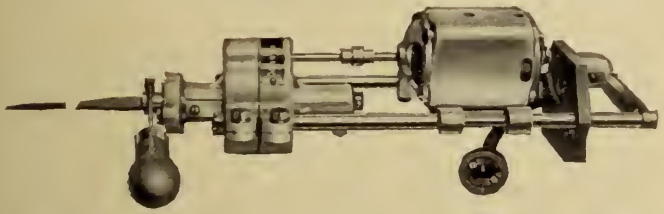
The illustration shows a portable generating equipment made up by C. W. Parker, manufacturer of amusement devices of all kinds. The outfit consists of a "Standard" 115 volt, compound-wound, direct current generator, made by the Robbins & Myers Company, Springfield, Ohio, mounted with a gasoline engine on a steel frame truck. The engine is of the automobile type and is connected to the generator by a short belt with idler pulley attachment.



To meet the requirements of the various devices with which these generating outfits are used, four sizes are made, using Robbins & Myers generators of 2, 3, 5, 7½ and 10 kw. capacity.

A New Electric Drill

The cut herewith represents an electric drill manufactured and sold by the Electric Tachometer Company, Philadelphia, and sold in Canada by R. E. T. Pringle, Toronto. The "Locke Electric Drill" is made in two sizes, requiring 1/16 and 1/8 h.p. A universal motor is used. The "Locke Electric Drill" is designed for drilling holes in concrete floors for carpet sockets; in bathroom tiling for attaching fixtures; drilling holes for attaching fire extinguishers, securiny theatre seats, attaching window awnings, fire escapes, iron railings, mounting signs; cutting holes in concrete by drilling a series of small holes and breaking out the solid part by the plug and feather system; drilling holes in partitions for electric wires or conduits, steam and water pipes; drilling and chipping square holes in marble panel work for electric fixtures; drilling holes for attaching racks for telephone or signal wires to stone or concrete abutments of railroad bridges or retaining walls; for drilling holes in concrete floors for mounting machinery; and for a variety of other purposes.



New Hubbell Receptacle

The cut herewith represents a new flush receptacle just placed on the market by the Harvey-Hubbell Inc., Bridgeport. This new device presents an absolutely flush surface when the device is in use as well as when the cap is removed. The cap is also very small and much neater in appearance than those interchangeable with the general line of receptacles corresponding to the regular types manufactured by this company. These new types have also concealed contacts insuring freedom from short circuits and shock.

Developing Fan Sales

The Robbins & Myers Company are distributing a folder to electrical dealers and contractors in which they offer assistance in developing fan sales. One of the methods of assistance is by supplying local papers with cuts showing the advantage and comfort following the use of electric fans.

New Companies

The Electric Furnace Products Company, Limited, has been incorporated with capital $5,000,000 and head office Toronto. The company is given power to build and operate electric plants manufacturing calcium carbide and allied products in Canada and Norway.

It is said that work on the electrification of the Kerr Lake branch of the T. & N. O. Railway will be commenced early in May. This will be operated as part of the present Nipissing Central system.

Personal

Mr. A. F. Moray is leaving the Shawinigan Water and Power Company to take up construction work with the Cedars Rapids Manufacturing & Power Company, Cedars, Que.

Mr. E. I. Sifton has been appointed the first general manager of the Hamilton hydro-electric system. Mr. Sifton has been in charge of the construction work on the Hamilton system as chief engineer since its beginning.

Mr. G. F. Drewry, B.Sc., has just joined the Toronto section of the Ferranti Electrical Company as general sales engineer, his particular function being to assist in the development of the business of this firm in connection with their representation of Messrs. Bruce Peebles. Mr. Drewry was previously district manger in Winnipeg for the Allis-Chalmers-Bullock Company and more recently was sales engineer for the Canadian Allis-Chalmers, Limited.

Trade Publications

Coal Conservation.—A report on "Conservation of coal in Canada" compiled by W. J. Dick, Mining Engineer of the Commission of Conservation.

Unilets.—The Appleton Electric Company of Chicago have just issued a very complete catalogue illustrating and describing their line of unilets and conduit fittings.

Small D.C. Generators.—Bulletin No. A4188, issued by the Canadian General Electric Company, describing and illustrating their small belted type direct current generators.

Starting Switches.—Bulletin B531, February, 1914, issued by the Allen-Bradley Company, Milwaukee, describing their type G. starting switch for small induction motors which do not require a starting resistance to limit the current.

Electrical Specialties. Catalogue 15, issued by Harvey Hubbell, Inc., Bridgeport, Conn., describing the Hubbell electrical specialties; one of the most complete catalogues ever issued on this subject. It contains 175 pages of well-illustrated descriptive matter.

Stream Measurements.—Report of progress of stream measurements for the calendar year 1912, just issued by the Department of the Interior for the Dominion of Canada. This report has been prepared under the direction of F. H. Peters, C.E., Commissioner of Irrigation by P. M. Saunders, A. M. Can. Soc. C. E., chief hydrographer.

Link-Belt Silent Chain.—Data book No. 125, issued by the Link-Belt Company, Chicago, giving complete engineering information on silent chain drive in a simple and compact form. This data book describes many different uses of silent chains for the efficient transmission of power and gives specific reasons and illustrations showing its application in a large variety of uses. The book is claimed to be the only work of its kind.

Telephone Report—A report issued by the Department of Telephones of the Province of Saskatchewan covering the financial year ending February 28, 1913. Subscribers to the government system have increased during the past year by about 5,000, bringing the total number served to almost 15,000. The system now comprises 3,172 pole miles and 11,857 wire miles of long distance telephones. To the 15,000 subscribers served by the government system may be added some 9,000 being served through rural, municipal and private systems representing a total of 24,000 telephone subscribers within the province. There are 187 rural companies connected up with the government exchanges. The number of incorporated independent telephone companies in this province is 25, municipal telephones 5, and rural telephone companies 337.

Current News and Notes

Beloeil, Que.

Armours, Limited, Montreal, have secured a contract for a domestic and street lighting and power system at Beloeil, P.Q. The Southern Canada Power Company are building a transmission line from Richelieu to the outskirts of Beloeil, and the municipality will continue this line through the town, a distance of five miles. The power, supplied by the Montreal Light, Heat and Power Company on the 50,000 volt transmission line, will be stepped down to 2,300 volt in a small transformer station at the town line, which will be carried on cedar poles 30 feet high and erected 42 per mile. The street lights will be 100-80 c.p. mazda series lamps, connected by goose-neck brackets and fitted with corrugated metal reflectors. For the street lighting, there will be a 10 kw. transformer, and for the domestic service two 20 kw., one 15 kw., and twelve 7½ kw. transformers. On the primary line No. 4 double braid weather-proof wire will be used, and for the secondary lighting and series No. 6 will be employed.

Chatham, Ont.

Negotiations are still proceeding between the Chatham Gas Company and the Hydro-electric Power Commission for the purchase of the plant of the former for the sum of $410,000 plus the cost of extensions since the date of the commencement of negotiations. According to a reported statement of Mr. P. S. Coate, manager of the company, the only point at issue now is some $25,000 for supplies on hand. If negotiations fall through the Commission recommend the erection of a municipal distributing system at a cost of some $90,000. It is to be hoped the sum of $25,000 will not stand in the way of an amicable arrangement for the purchase of this system in view of the unsatisfactory results which have followed the duplication of systems in the towns and cities where the private plants were not purchased.

Chandler, Que.

The Parsons Pulp & Lumber Company are installing 27 induction motors throughout the different departments of their pulp mill at Chandler, Que. These motors are being supplied by the Canadian Crocker-Wheeler Company. Our item in reference to this plant which appeared in the April 15 issue would make it appear that this equipment was supplied by another company.

Calgary, Alta.

A by-law will be submitted on April 30th authorizing the expenditure of $300,000 on electric light extensions.

Edmonton, Alta.

A by-law has been passed authorizing the expenditure of $168,000 on street railway extensions.

Embro, Ont.

On April 24 the ratepayers voted on a by-law authorizing the council to close a contract with the Hydro-electric Power Commission of Ontario.

Fort William, Ont.

The committee appointed to investigate the matter have reported on the advisability of Fort William's purchasing their power from the Kaministiquia Power Company at 22,000 volts. This will necessitate the erection of a step-down station and the purchase and installation of transforming equipment.

Property owners on Arthur street, between Franklin street and the western limits of the city are working on a scheme for an extension of the street railway from Franklin street west to the western limits of our city. It is proposed to construct the road by private subscriptions, and when completed to turn it over to the city, free of encumbrances, for operation.

Hamilton, Ont.

It is reported that Engineer Sifton's estimate on the cost of installing a lighting system on certain sections of the mountain has been approved.

London, Ont.

The request of the London, Grand Bend and Stratford Railway Company for permission to operate their cars over the tracks of the London Street Railway was refused by the Railway Committee of the provincial legislature.

Montreal, Que.

The Southern Canada Power Company, Limited, are constructing a 50,000 volt transmission line from Richelieu to Sherbrooke. At present the line will be built to St. Hyacinthe, but it is planned to eventually continue it to Drummondville and to Sherbrooke. The company recently acquired the plants and properties of the South Shore Power Company, the St. Hyacinthe Gas and Electric Company, and the St. Johns Electric Company, and also control three water powers on the St. Francis River near Drummondville, capable of developing 30,000 horse power. The idea is to eventually link up these various plants, and to form the now scattered units into a complete system for supplying light and power. The lines will be carried mainly on cedar poles, about 35 feet high, but it will be necessary to construct steel towers 135 feet high where rivers have to be crossed. Part of the power is to be supplied for the present by the Montreal Light, Heat and Power Company. J. M. Robertson, Limited, Montreal, are the consulting engineers.

At the annual meeting of the Maritime, Coal, Railway and Power Company, held in Montreal, on April 18, it was announced that the net profits were $116,000, a gain of 16 per cent. It is proposed to increase the output of the colleries, and with this view six new electric coal cutters have been purchased and three intsalled. During the past year the plant for supplying electric power at Amherst, N.S., has been doubled.

There was a large attendance of the members of the Montreal Electrical Society at the second annual dinner, held at the Commercial Travellers' Club, Read Building, on April 15. Mr. T. H. Nicholson presided. The toast list was limited to four toasts. "The Society" was proposed by Professor A. M. Gray, of McGill University, who referred to the part engineers played in developing the wealth of the country, and to the experimental work which is being carried out by Canadian electrical engineers. Canadian engineers were now coming into competition with men from other countries who perhaps had a better training than those in this country, and he urged the absolute necessity of technical education in order that Canadians should keep their positions in the electrical world. They had to rely to a certain extent on text books from Great Britain and Europe, which in some respects were not quite suitable to our conditions, and Professor Gray instanced the prominence given to the study of direct current in Europe and the great use of alternating current in Canada. Mr. P. T. Davies replied, and referred to the combination in the society of social intercourse and technical lectures. In proposing "The Executive," Mr. T. R. Campbell stated that they represented every branch of the electrical industry. Mr. W. H. Winter responded and appealed for a closer co-operation between the members and the officers. "Our Guests," proposed by Mr. J. N. Mochon, was replied to by Mr. F. C. Burnett, who declared that the old idea of keeping knowledge to oneself had died, and that the practice to-day was along the lines of co-operation.

Earnings of the Shawinigan Water and Power Company for March were $141,815, the largest monthly total in the history of the company. This figure compares with $133,240 in March, 1913, an increase of $8,575.

Mr. J. M. Forbes, of Forbes & McCormick, Montreal, has been engaged by the Quebec Railway, Light, Heat and Power Company to carry out work to remedy certain defects in the general system reported on by Mr. James Bennett of Montreal, by authority of the Quebec Public Utilities Commission. Mr. Forbes and Mr. Bennett have visited Quebec for the purpose of supervising the work which was ordered to be done by the Commission.

The proprietors of the city of Westmount, P.Q., having passed the necessary by-law, the Council are proceeding with the extension of an improved lighting system. A sum of $8,000 has been voted for additional 6.6 ampere magnetite arc lamps and for standards. A sum of $10,000 will also be provided for laying underground conduits, the work to be done by day labor.

The Cedars Rapids Manufacturing and Power Company have let the contract for a 66,000 volt transmission line, which will run from the plant to the step-down station at Cote St. Paul, a suburb of Montreal, a distance of about 30 miles. The Canadian Allis-Chalmers, Limited, will supply the steel poles, which will be lattice type, 40 feet high. The wires will be aluminum, steel reinforced, manufactured by the Northern Aluminum Company, Shawinigan Falls.

Ottawa, Ont.

The W. C. Edwards Lumber Company have been temporarily refused an extension of their charter which would allow them to generate and sell electric power. It is feared that the company's operations might interfere with the work of the Ontario Hydro-electric Power Commission in Eastern Ontario.

Outremont, Que.

On the recommendation of Dr. L. A. Herdt, their consulting electrical engineer, the Outremont Council have accepted the tender of the William Hamilton Company, Limited, Peterboro, for electric light standards to be used in connection with a new system of street lighting. The company will supply 12 large combined lighting and trolley standards and 375 small standards for the side streets.

Owen Sound, Ont.

There is some talk of an electric railway in Owen Sound. A twenty-five year franchise is being asked by a private syndicate.

Prince Rupert, Sask.

Tenders have been received for the equipment necessary for the initial development of hydro-electric energy for the city of Prince Rupert.

Portage La Prairie, Man.

The special power committee recently appointed by the city council have made a preliminary report on the hydro-electric power possibilities for Portage La Prairie. They recommended that they be given further authority to confer with an engineer of experience and integrity to verify figures already in hand. It is considered possible that the city of Brandon may co-operate in the joint ownership of a transmission line from Winnipeg.

Regina, Sask.

The city of Regina has decided to purchase four new street cars. A considerable reduction in power rates will probably go into force in Regina within the near future, the civic utilities committee having decided to grant various concessions in the interests of the power user.

The operating returns for the municipal street railway system, Regina, for the week ending April 4th are as follows: revenue $4,094.85; passengers carried 95,436; passengers carried including transfers, 106,520. The corresponding figures for the week ending April 11th are as follows: $3,776.20, 92,251 and 103,468.

Thorold, Ont.

The town council have passed a by-law granting a right of way to the St. Catharines, Merriton & Thorold Electric Railway, into the factory district.

Toefield, Alta.

The people of Toefield are agitating for a municipal light plant, but owing to the financial condition of the town they have not yet been able to start the undertaking.

Toronto, Ont.

The estimates for the year include the providing of sufficient capital to add some 8,000 new lamps to the street illumination system.

The provincial estimates include an item of approximately $5,000,000 for extensions to the Ontario Hydro-electric system. The principal items are as follows:—Niagara system extensions, $3,421,786; Severn system, $550,000; Wasdell's Falls, $191,751; St. Lawrence system, $22,680; Port Arthur system, $20,513; Eugenia Falls system, Grey county, $250,000; Office building, $150,000; estimates on account of provincial work, $165,000.

The Hon. Adam Beck has introduced a new hydro-radial bill in the local legislature. The new bill repeals the legislation of last session and provides for the financing and operation of radials on an entirely new basis. Instead of the money being raised by municipalities through the sale of their debentures, bonds guaranteed by the province may be issued by the Hydro-electric Power Commission, as it is believed that these can be marketed to better advantage than by the municipalities. In order to make the load on the different municipalities as light as possible sinking fund charges will not be commenced for ten years. The bonds run for fifty years. The operation of the radials is taken out of the hands of the municipalities in this new bill and placed in the hands of the Hydro-electric Power Commission. The explanation given for this change is that it might be difficult to insure proper management of a number of small isolated systems and that the Commission is in a better position to appoint suitable men and to take charge of, in one office, much of the work that would necessarily be many times duplicated.

Vermillion, Alta.

The Town of Vermillion will soon be adding another unit of 50 kw. to its present power plant as it is now overloaded and cannot take care of the business offered.

The C. N. R. are sinking a well of 30 ft. diameter and approximately 35 ft. deep to supply their terminal with water. The pump will be a centrifugal driven by a thirty horsepower 500 volts, 3-phase, 60-cycle induction motor.

Vegreville, Alta.

The town of Vegreville have instructed Messrs. Maxwell and McKenzie to proceed with the plan and specification for a light and power plant to compete with the present light company. The by-laws were voted on in 1913 but owing to the condition of the financial market the town council could not sell their debentures and the matter was postponed until this spring. The situation in Vegreville is rather complicated, the present light company has a franchise good for nine years, but the town claims that the service has been so unsatisfactory and the capital so limited that the company could not extend their lines to take care of the newer part of the town. Also their generating equipment being operated at full capacity they could not add on any more load.

Woodstock, Ont.

The water and light commissioners are considering the erection of a small sub-station and the purchase of the necessary transformers to take care of the increased requirements of the northwest section of the city.

Woodbridge, Ont.

On April 12 the ratepayers voted to spend $6,000 on a hydro-electric distribution system.

Walkerville, Ont.

A contract for the building of a low tension transforming station in Walkerville has been awarded to Wells & Gray.

Windsor, Ont.

A contract has been awarded by the city of Windsor to the William Hamilton Company, Peterboro, for the supply of all the ornamental iron standards required for the new street lighting system to be installed in the business district of the city of Windsor. There will be approximately 300 of these standards probably each equipped with magnetite arc lamps.

A contract for the erection of the transforming station has been awarded to the H. Christman Company of Hamilton.

Welland, Ont.

The Union Carbide Company have placed an order with the Siemens Company of Canada for a quantity of 46,000 volt single conductor cable. The cable will be paper insulated and lead covered and will, we believe, be the highest voltage cable installed in Canada to date. The specifications call for a test of 100,000 volts, both after manufacture and after installation.

Winnipeg, Man.

The Manitoba Government will build a new telephone exchange to take care of the St. James district.

A contract for the extension for the May Street substation has been awarded to G. H. Archibald.

The sixth annual report of the Manitoba Government telephones, which covers the fiscal year ending November 30, 1913, is just to hand. Substantial increases have been made during the year in the number of telephones. The total number of telephones in use is now 48,094, a gain of 5,173 for the year. These are, for the most part, government telephones. The total number of exchanges now operated by the government is 124 as against 16 operated by private companies and local municipalities. The number of urban subscribers to the government system is 34,039 as against 11,242 rural subscribers. The other systems have 483 urban subscribers and 2,330 rural. The total revenue for the year was $1,707,149; gross expenses $1,269,909, leaving net earnings of $437,240. The interest charges for the year take $406,975, leaving $30,265. Of this amount $26,691 is carried to replacing account, leaving a net balance of $3,574. The balance sheet indicates the total assets of the system to be $10,666,829.

The Siemens Company of Canada are shipping a 500 kw. motor-generator set for the King Street sub-station, Winnipeg. The unit consists of a 500 kw. d.c. compound wound generator, with commutation poles, 550/605 volts, 720 r.p.m. direct connected and mounted on the same bedplate with one self-starting synchronous motor 3-phase, 2200 volt, 60-cycles, with direct connected exciter. The necessary starters and rheostats are also included.

Lighting Schedule for May, 1914

Courtesy of the National Carbon Company, Cleveland.

Date.	Light.	Date.	Extinguish.	No. of Hours
May 1	11 30	May 2	4 10	4 40
3	0 00	3	4 10	4 10
4	0 30	4	4 10	3 40
5	1 00	5	4 10	3 10
6	1 20	6	4 10	2 50
7	1 50	7	4 10	2 20
8	2 10	8	4 10	2 00
9	No Light	9	No Light	
10	7 30	10	10 10	2 40
11	7 30	11	11 30	4 00
12	7 30	13	0 30	5 00
13	7 40	14	1 20	5 40
14	7 40	15	1 50	6 10
15	7 40	16	2 20	6 40
16	7 40	17	2 40	7 00
17	7 40	18	3 00	7 20
18	7 40	19	3 20	7 40
19	7 40	20	3 40	8 00
20	7 40	21	3 50	8 10
21	7 40	22	3 50	8 10
22	7 50	23	3 50	8 00
23	7 50	24	3 50	8 00
24	7 50	25	3 50	8 00
25	7 50	26	3 50	8 00
26	7 50	27	3 50	8 00
27	7 50	28	3 50	8 00
28	7 50	29	3 50	8 00
29	10 00	30	3 50	5 50
30	10 40	31	3 50	5 10
31	11 00	June 1	3 50	4 50

Total Hours............171 10

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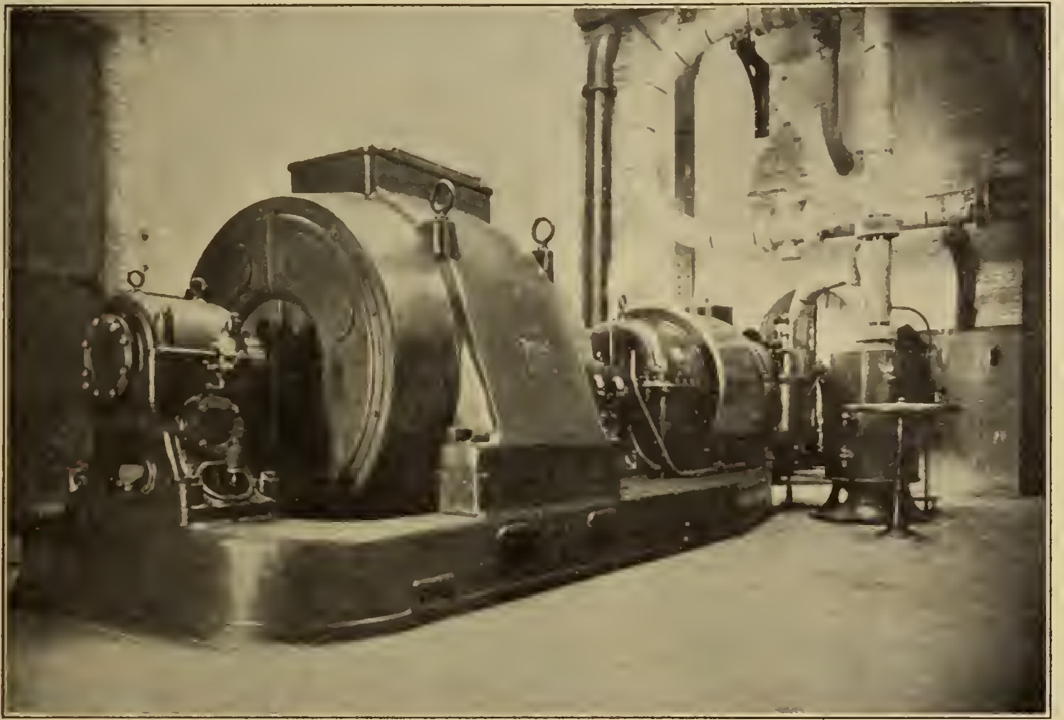

Siemens 1200 K.W. 60 cycle 2-phase, 3600 r.p.m., 2200 Volt, Turbo-Generator, supplied to Lethbridge, Alberta

The following Siemens TURBO GENERATORS have been supplied, or are on order for Canada:—

1—4000 K.W., Edmonton.
1—3000 K.W., Regina.
1—2500 K.W., Dominion Coal Company.
1—2000 K.W., Dawson City.
1—2000 K.W., Dawson City.
1—2000 K.W., Dawson City.
1—2000 K.W., Edmonton.
1—1500 K.W., Regina.
1—1500 K.W., Regina.
1—1500 K.W., Moose Jaw.
1—1200 K.W., Lethbridge.
1— 750 K.W.,Nova Scotia Steel & Coal Company.
1— 675 K.W., Medicine Hat.
1— 675 K.W., Medicine Hat.
1— 500 K.W., Nova Scotia Steel & Coal Co.
1— 500 K.W., Nova Scotia Steel & Coal Co.
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All advertisements must be in the publisher's hands by the 10th or 23rd of the month to insure insertion in the subsequent issue.

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The proprietors of letters Patent No. 127080 relating to "Process of Manufacturing Iron Electrodes for use in Alkaline Accumulators," and No. 127081 relating to "Active Masses for Positive Electrodes of Electric Elements, etc.," desire to dispose of the Patents or to grant Licenses to interested parties at reasonable terms with a view to the adequate working of the Patents in Canada.

Inquiries to be addressed to the actual proprietors, Svenska Accumulator Aktiebolaget Jungner, Stockholm, Sweden. F

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Position Wanted—Electrical Engineer, Associate A. I. E. E., age 33. Thirteen years' practical experience with D.C. and A.C. machinery, Accumulators, Line erection and maintenance, High speed steam engines and water power plants. At present in charge of Suction gas plant. Box 11, Electrical News, Toronto. 9-13

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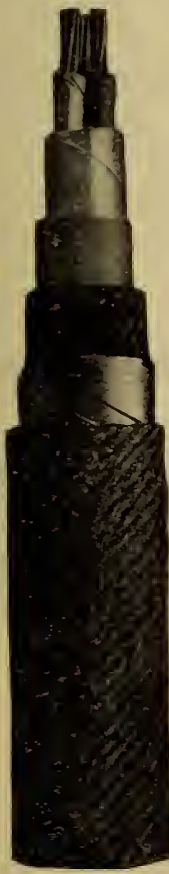

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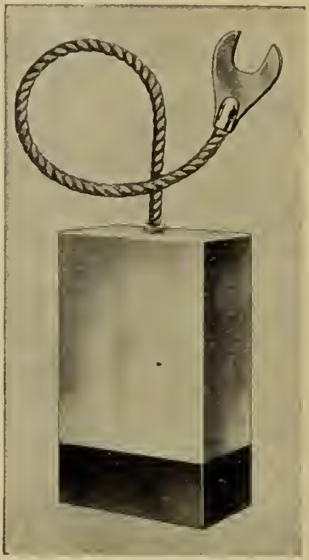

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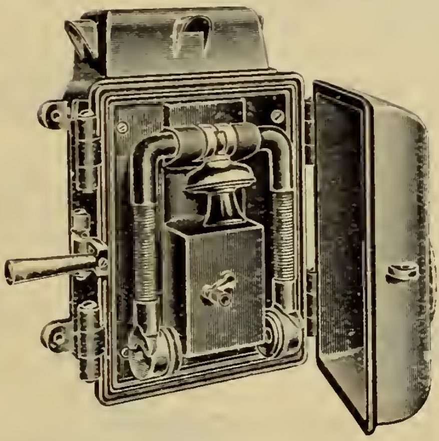

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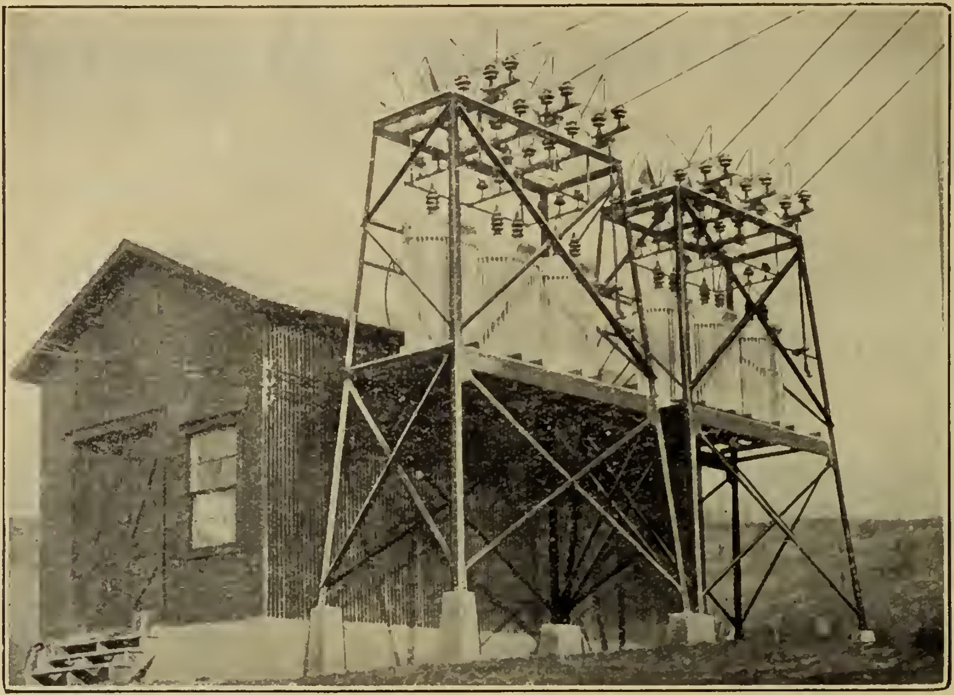

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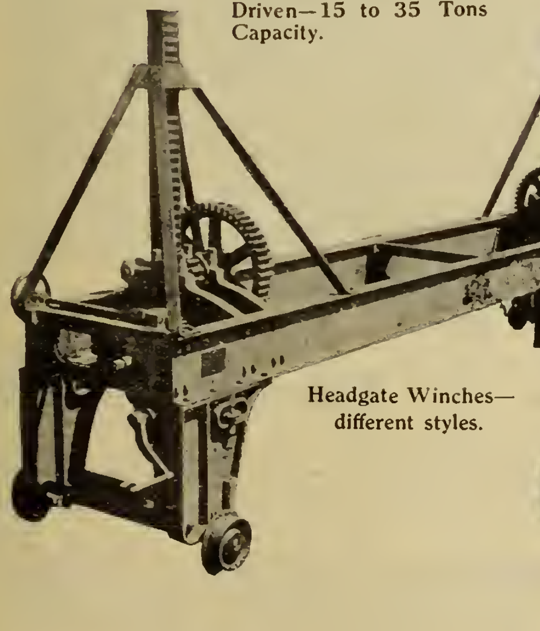

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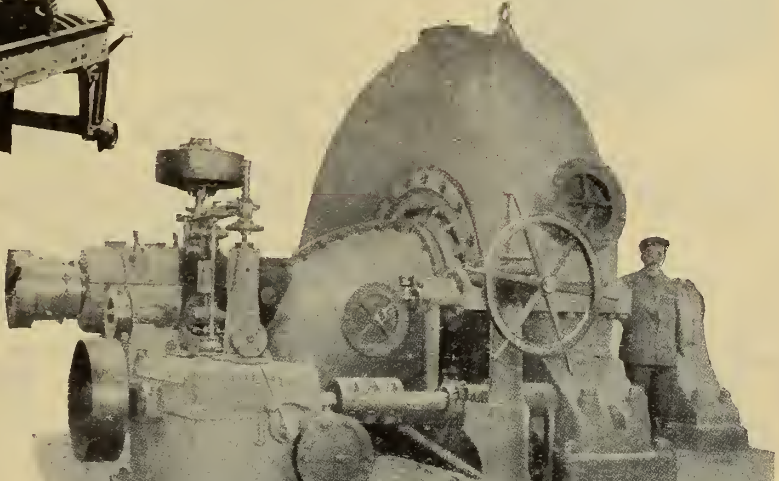

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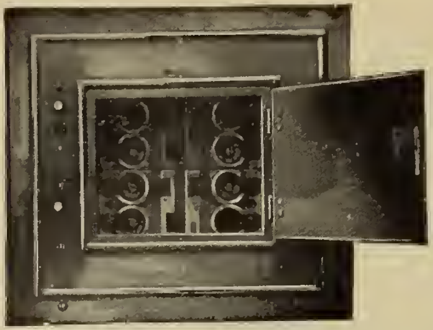

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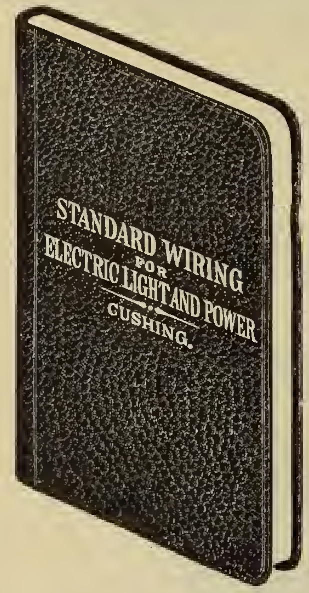

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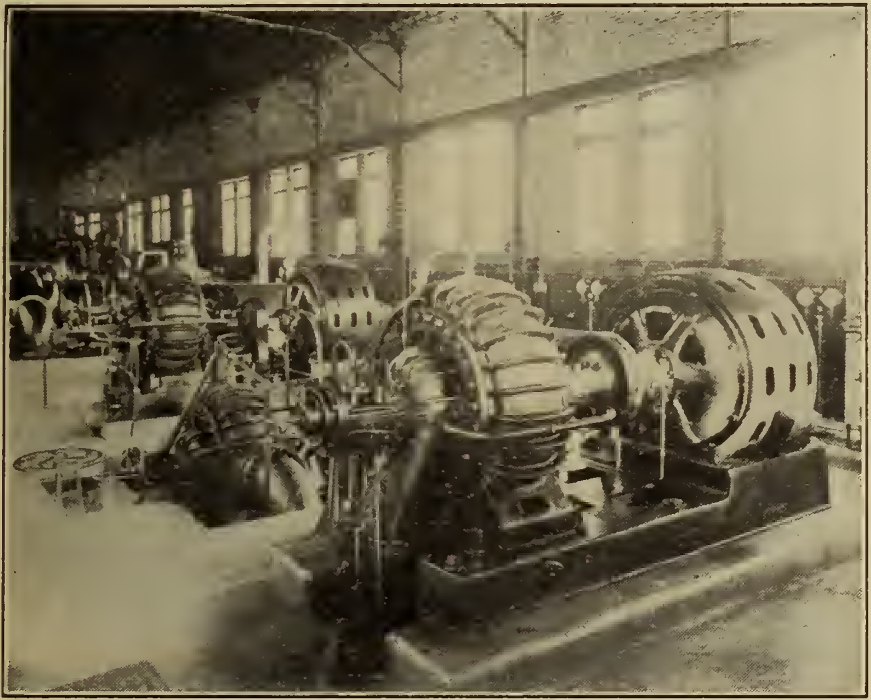

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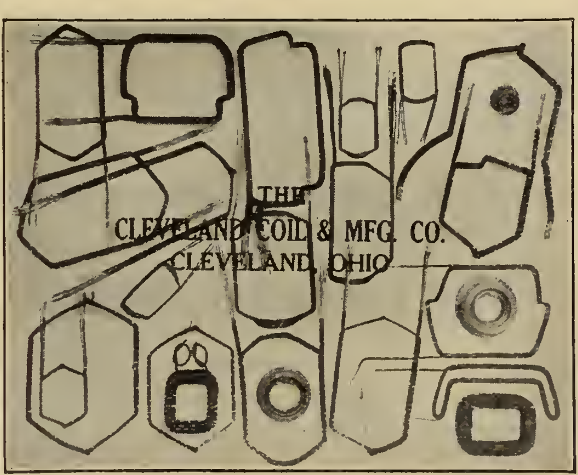

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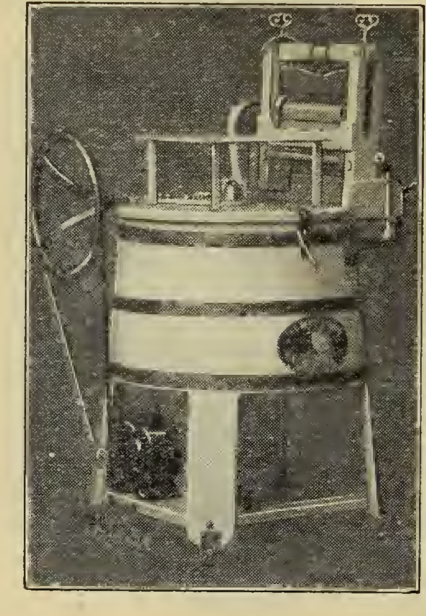

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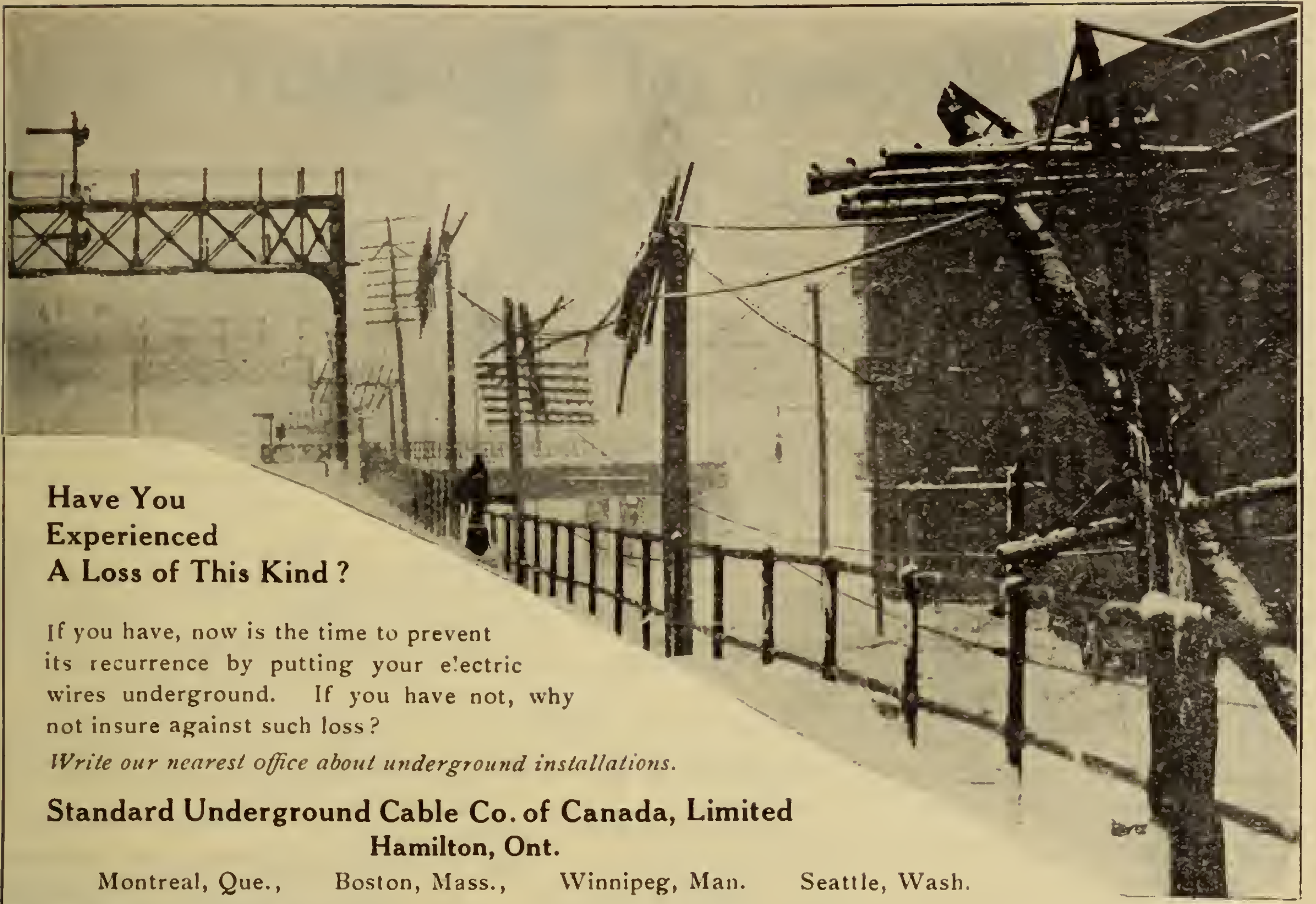

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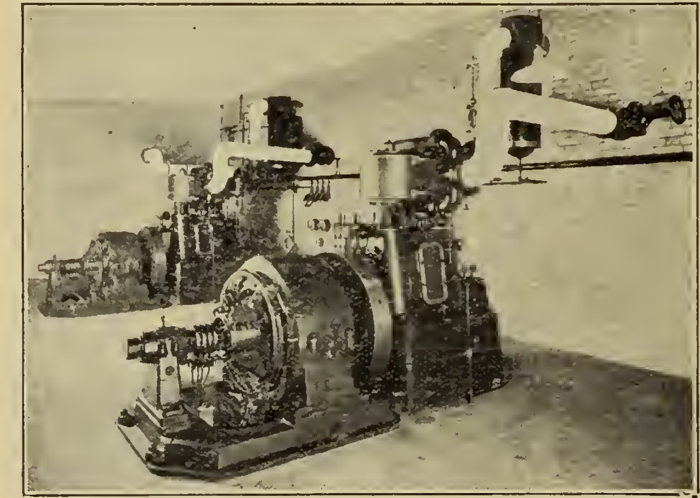

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'Elementary Telegraphy," by Pendry. Published in 1910 by Whittaker & Company. Price $1.00.

'Direct and Alternating Current Testing," by Bedell. Published in 1909 by D. Van Nostrand & Company. Price $2.00.

"A Laboratory Manual of Alternating Currents" by John H. Morecroft, E.E. Published in 1912 by Renouf Publishing Company. Price $2.00.

"Electricians' Operating and Testing Manual," by Henry C. Horstmann and Victor H. Tousley. Published in 1910 by Frederick J. Drake & Company. Price $1.50.

"Telephony," by Samuel G. McMeen and Kempster B. Miller. Published in 1912 by the American School of Correspondence. Price $3.00.

"Elevators, Hydraulic & Electric," by Calvin F. Swingle. Published in 1910 by Frederick J. Drake & Company. Price $1.00.

"The Electric Motor and Its Practical Operation," by Elmer E. Burns. Published in 1912 by Joseph G. Branch Publishing Company. Price $1.00.

'Electric Wiring & Lighting," by Charles E. Knox, E.E. Published in 1913 by the American School of Correspondence. Price $1.50.

"Electric Arcs," by Clement D. Child, Ph.D. Published in 1913 by D. Van Nostrand Company. Price $2.00.

"Conversations in Electricity," by Branch. Published in 1908 by the Branch Publishing Company. Price $2.00.

'A. C. Machinery," by Esty. Published in 1912 by the American School of Correspondence. Price $4.00.

'Wireless Telegraphy and Wireless Telephony," by Ashley-Hayward. Published in 1911 by the American School of Correspondence. Price $1.50.

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→ No. 21 ←

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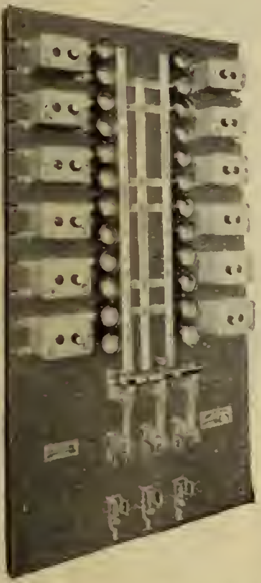

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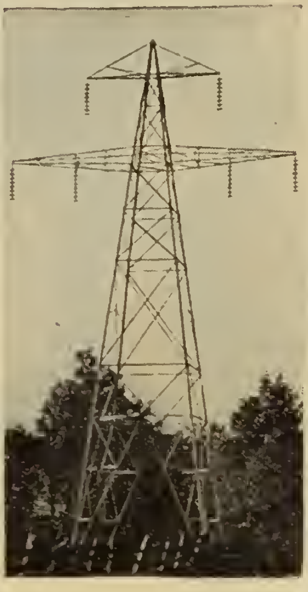

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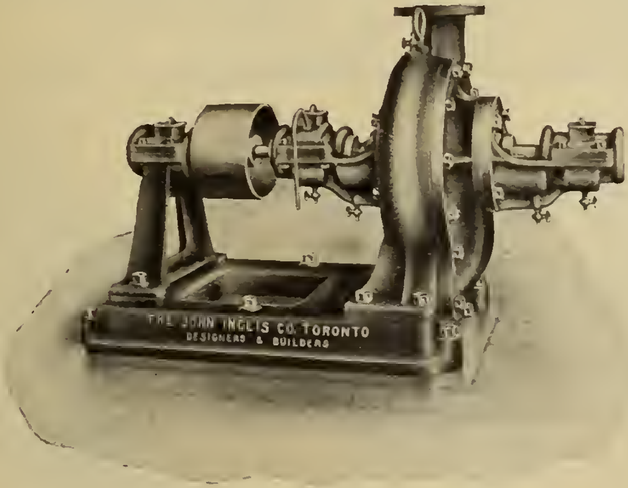

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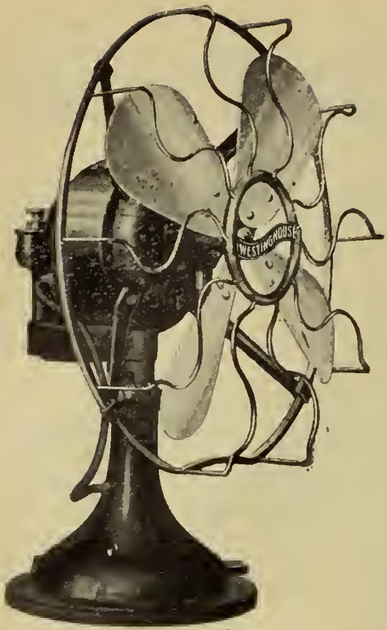

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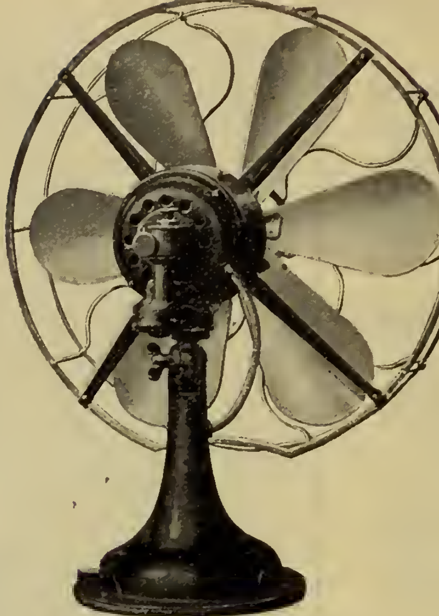

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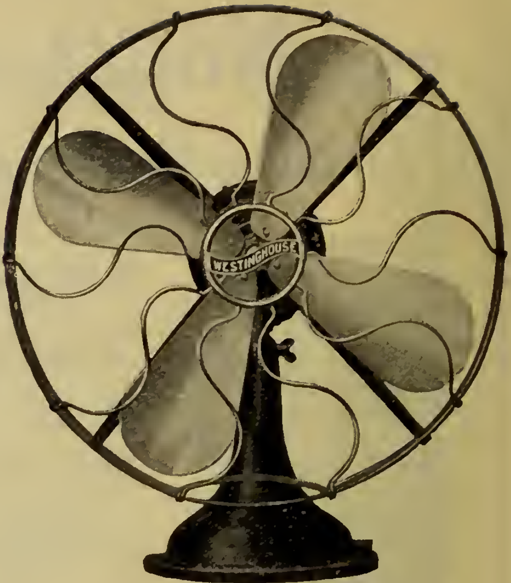

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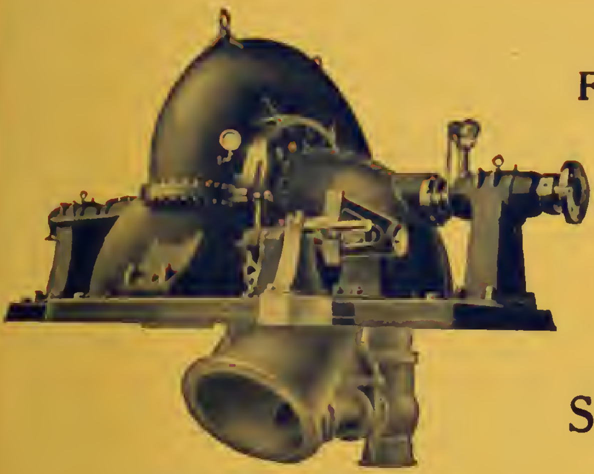
Vol. XXIII—No. 10 Toronto, May 15, 1914

Electrical News

Generation, Transmission and Application of Electricity



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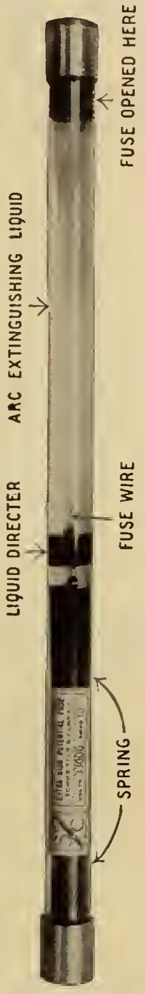

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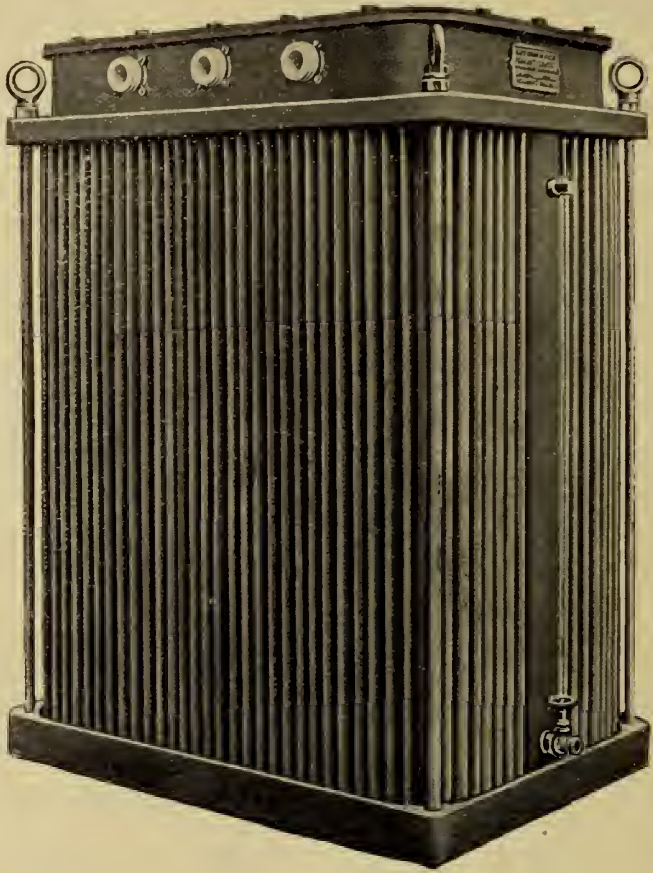

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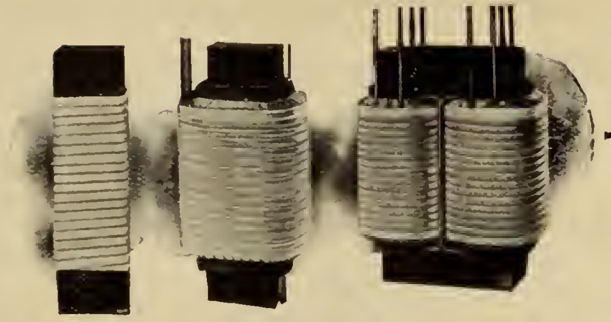

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GALVADUCT

Graphic Arts Building, Toronto. A "GALVADUCT" Building.

LORICATED

"GALVADUCT"

The most perfect interior construction conduit on the market.

Recognized as the standard of high quality.

Always specify Galvaduct or Loricated conduits

"LORICATED"

A high-class interior construction conduit of the enamelled type, proof against acid or other corrosive agents.

If your jobber cannot supply you—write us

USED IN THE FINEST BUILDINGS IN CANADA

Conduits Company Limited

Toronto - - Montreal

I-T-E

CIRCUIT BREAKER

Every once in a while we do something foolish: most people do. We try to build a cheap circuit breaker and we always fail—it never comes out cheap.

I-T-E standards are too high, our Engineering Department designs too well, too good material is used, and too much of it, our shop work is too good, our finish is too fine, our tests are too exacting.

With us every man in his department is a specialist trained to do the best he knows how. Under these circumstances how can we build a cheap piece of apparatus? The answer is we cannot.

But give us a problem that demands the best, give us the most exacting conditions, and we make good.

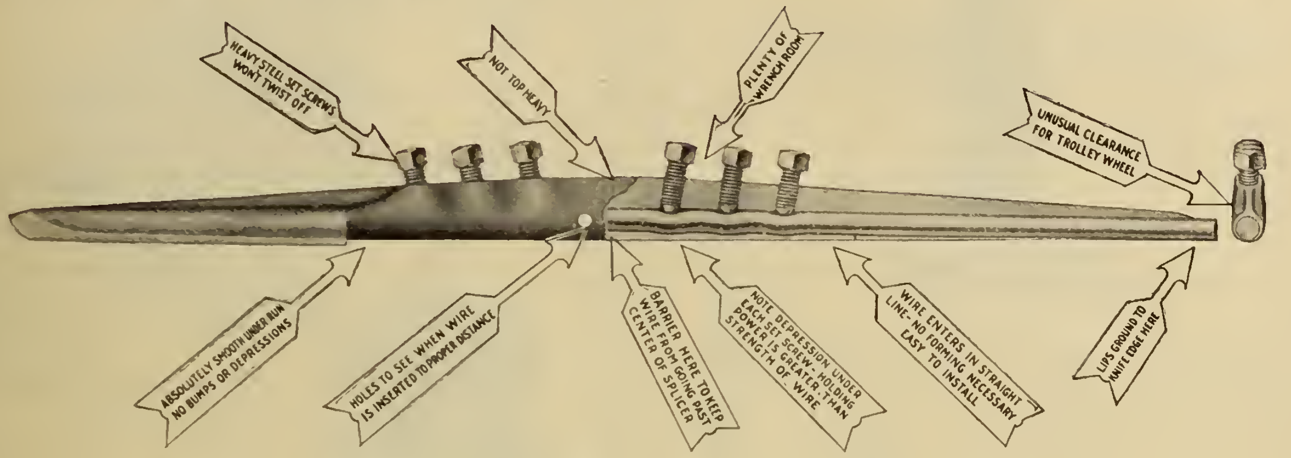
The experience of twenty-five years is at your service.

The Cutter Company, Main Office and Factory **Philadelphia**

The Cutter Company, 120 Liberty Street, New York.
The Cutter Company, Monadnock Block, Chicago.
The Cutter Company, Park Building, Pittsburgh.
The Cutter Company, Traders Bank Bldg., Toronto Canada.
The Cutter Company, Metropolitan Life Building, Minneapolis, Minn

The Cutter Company, Telephone Building, Indianapolis.
The Cutter Company, Woodward Building, Washington, D.C.
The Cutter Company, Ford Building, Detroit.
The Cutter Company, Pabst Building, Milwaukee.
Eccles & Smith Co., Los Angeles, San Francisco, Portland, Ore.
Frank Darling & Co., Vancouver, B. C.
Electric Manufacturers Sales Company, Denver

New O-B Type C Trolley Wire Splicer


HEAVY STEEL SET SCREWS WON'T TWIST OFF
NOT TOP HEAVY
PLENTY OF WRENCH ROOM
UNUSUAL CLEARANCE FOR TROLLEY WHEEL
ABSOLUTELY SMOOTH UNDER RUN NO BUMPS OR DEPRESSIONS
HOLES TO SEE WHEN WIRE IS INSERTED TO PROPER DISTANCE
BARRIER HERE TO KEEP WIRE FROM GOING PAST CENTER OF SPLICER
NOTE DEPRESSION UNDER EACH SET SCREW. HOLDING POWER IS GREATER THAN STRENGTH OF WIRE
WIRE ENTERS IN STRAIGHT LINE - NO FORMING NECESSARY EASY TO INSTALL
LIPS GROUND TO KNIFE EDGE HERE

Holds badly worn wire just as tightly as new wire. Made of high strength bronze, with or without boss. Length 20 inches.

Order some Type C Splicers today

The Ohio Brass Co., Mansfield, Ohio, U. S. A.

XCELADUCT GALVANIZED and ORPENITE ENAMELLED CONDUITS

These two brands of Interior Conduits represent the acme of Canadian made products.

XCELADUCT — this exceptionally high-grade galvanized conduit is made of easy-bending spellarized steel tubing. Copper subcoat and a zinc coating doubly protects it against rust, corrosion and atmospheric conditions.

ORPENITE CONDUIT—A specially prepared coating of enamel makes this conduit proof against rust and all weather conditions. It is made of easy-bending spellarized steel tubing.

In both brands of conduits the interior presents a smooth enamelled surface, which makes fishing rapid and easy—clean threads.

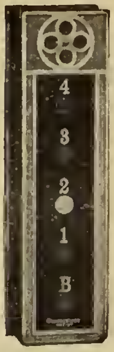
If your jobber does not carry a stock—write us.

ORPEN CONDUIT MANUFACTURING CO. OF CANADA
MANUFACTURERS OF XCELADUCT AND ORPENITE CONDUITS
HEAD OFFICE
TORONTO ONTARIO

The Sign of QUALITY FIRST

THE ORPEN CONDUIT
MANUFACTURING COMPANY OF CANADA
TORONTO MONTREAL

ALWAYS SPECIFY "EXCELADUCT" OR "ORPENITE."



CONNECTICUT

Electric Reset Annunciators

Illustration shows Type "M" a popular style "Connecticut Annunciator. Made also in a number of different sizes and styles. All Connecticut Annunciators.

Have These Advantages

- Resets electrically—singly or in groups.
- One set of batteries for call and reset.
- Occupies less space than other drops.
- Drop more sensitive than others—which means small current consumption.
- Reset button at bottom of case.
- No permanent magnets to demagnetize.

Write for Annunciator and Telephone Catalogs. We are the largest manufacturers of interior telephones in the U. S.

Connecticut Telephone & Electric Company, Inc.
Meriden, Conn., U. S. A.
Over 20 Years Experience.

When you have an opportunity why not be certain to add another Booster to your list of power customers, by installing for him a

Century

Single Phase Motor

which has been proved beyond question to give continued superior results under severe operating conditions.

We can ship from stock in Canada.

Bulletin No. 201 describes them.

Century Electric Company
19th, Olive to Pine Sts., ST. LOUIS, Mo.

CANADIAN AGENTS

Jones & Moore Electric Co., Ltd.
291 Adelaide St. W., Toronto
Mainer Electric Co., Ltd.
Winnipeg and Edmonton

Rudel-Belnap Machy. Co., Ltd.
Canadian Express Bldg., Mont.
Rankin & Cherrill
517 Main St., Vancouver

Tallman Fixtures
They're Different

Tallman's
Reputation is in the Goods.

Tallman Brass & Metal Co.
HAMILTON, ONT.

Electrical Decorative and Equipment Company
70 Lombard St. - Toronto, Ont.
Long distant phone Main 3634

Electrical and Flag Decorators and Designers

WE sell or rent all kinds of Electrical Signs, streamers of lights and other spectacular Electrical effects. We make a specialty of High Class Decorations for Street Fairs, Carnivals, Celebrations, Centennials, Old Home Weeks Street, Conventions, Conclaves, Parks, Buildings, Auto Shows, Balls, Fairs, Dances, Banquets, Industrial Expositions, Food Shows, Christmas and New Years, etc.

Our decorations are elaborate, appropriate and refined. We carry a complete line of Electrical Set Pieces, Signs, Streamers of Lights and Bunting for all Lodges, Orders and all occasions. Get our prices and designs for your occasion

HUBBELL PRESTURN SOCKETS CONCERN YOUR POCKETS

Every contractor installing sockets wants to install strength. The Hubbell Presturn Pull, Key and Keyless sockets are strong where the strain comes, and that is everywhere. Nineteen lugs in the cap snap into nineteen slots in the base. The gripping strength is all around the shell. That's why a Presturn cap cannot work loose.

A complete line of Presturn as well as all other Hubbell sockets and electrical specialties are in stock in Canada for immediate shipment in less than Standard Package lots if desired.

R. E. T. Pringle, 903 New Birks Bldg., Montreal

We Purchase Outright entire issues of bonds on steam and electric railroad, gas-electric and hydro-electric properties.

N. W. HARRIS & CO.

Established 1882
Incorporated 1911
35 Federal Street, Boston, U.S.A.

Use the Railway's Trolley Poles

as the basis of your new street lighting system. You can easily convert them into attractive Mazda Lamp Standards or arc lamp supports by use of

ERECO Combination Railway Lighting Pole Fixtures

This system, besides saving you the expense of underground construction, gets the wires up out of the way of traffic, where they are practically unnoticeable and the curb line is not crowded with separate lighting standards.

The progressive railway management will gladly co-operate with you with this object in view.

Design No. 10127.

Electric Railway Equipment Co.
Cincinnati, Ohio
Designers Manufacturers
Canadian Representatives:
Dawson & Co., Limited, Montreal, Winnipeg
N. Y. Office, 30 Church St., Hudson Terminal Bldg.

GEORGE ELLISON

Manufacturing Electrical Engineer,

SPECIALTIES

Prompt Delivery of

Air and Oil break full automatic,—
- A.C. & D.C. Circuit Breakers
- Auto-Transformer Starters
- Star-delta Starters

All details for Crane control,—
- Relay Type Crane Panels
- Drum Type Controllers A.C. & D.C.
- Brake Solenoids. Limit Switches

Adjustable Time Lags

Responsible representatives required for the Dominion

Address G. E. ETLINGER
c/o Canadian Express Co. MONTREAL

"Eclipse" Electric Heaters

5 Years Guarantee

A patented System, in Successful use all over the World.

Our Catalogue illustrates and decribes our 100 patterns.

No. 332 Connector

No. 388 Train and Car Heater.

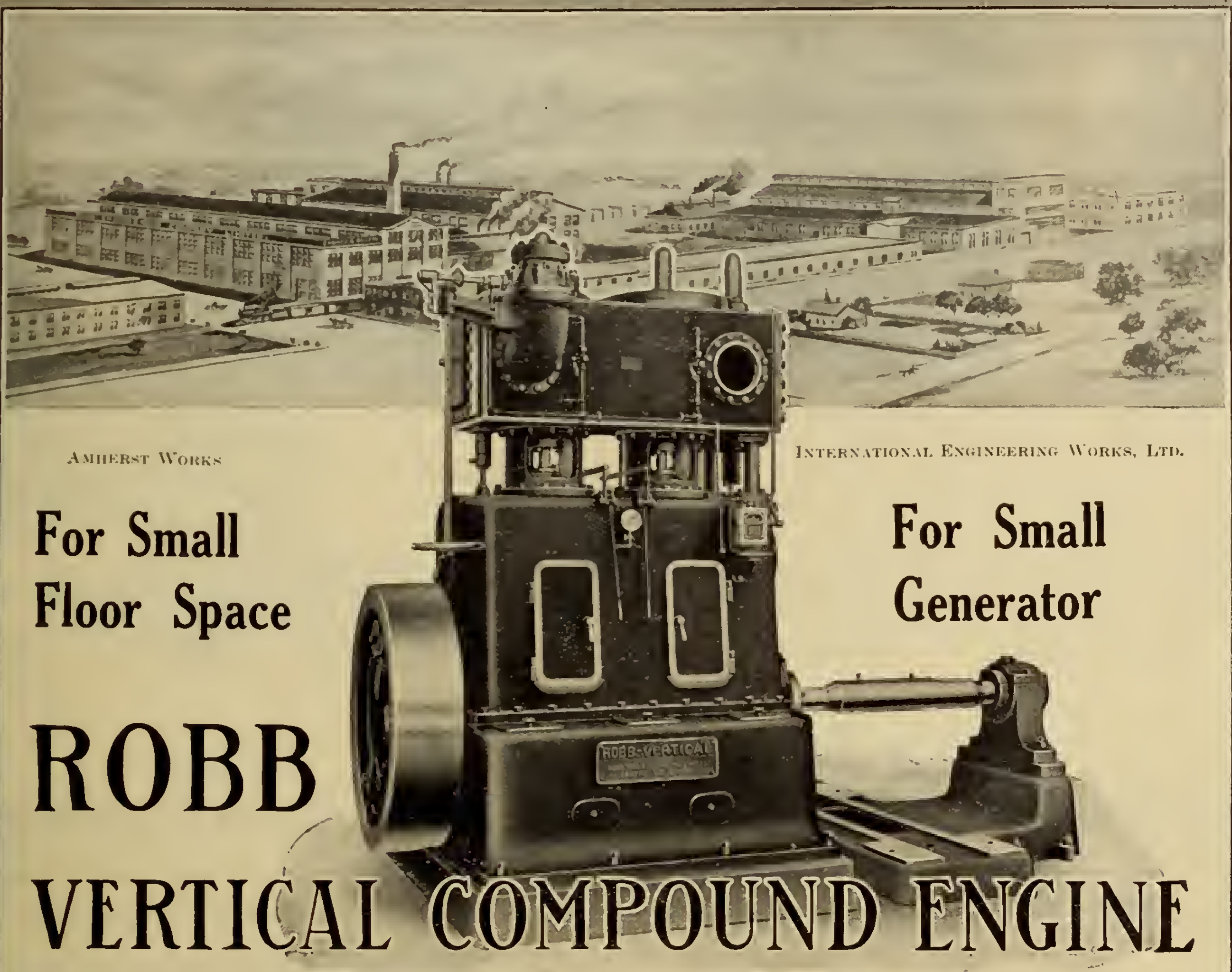
No. 405 Radiator

Can be procured in Canada from the Supply Authorities, Electrical Dealers, or from our Montreal office as under.

The Electric & Ordnance Accessories Company Limited

Head Office for Canada:—LEWIS BLDG., MONTREAL
Mr. J. P. I. Thomas (Representative)

Works:—Aston, Birmingham
ENGLAND



For Small Floor Space

For Small Generator

ROBB

VERTICAL COMPOUND ENGINE

High Speeds of Rotation with pistons of large diameter give a powerful engine in small space. The direct-connected generator can be of small diameter because of the high speed so that the unit will be of relatively low cost and small dimensions for a given kilowatt output.

Quiet and satisfactory operation at piston speeds of only 500 to 800 feet per minute make these engines particularly adapted to electric light plants and electric railway service—installations requiring high-grade durable engines which will operate under a great range of load.

Long periods of operation without attention are made possible by the system of forced lubrication which supplies all bearings with an abundance of oil.

Complete enclosure of all moving parts prevents oil from flying about and protects the parts from accidental injury.

Low Steam Consumption is due to the very small clearances, high speed, automatic governing, and refinement in finish.

Ask for Bulletin No. 201.

INTERNATIONAL
ENGINEERING WORKS, LIMITED

SO. FRAMINGHAM, MASS. **AMHERST, N.S.**
Montreal Winnipeg Edmonton Toronto Vancouver Calgary

39-70

SWITCH BOARDS—
- Live Face
- Dead Face
- Desk Boards
- Auto Charging Boards.

PANEL BOARDS—
- Standard Switch Panels
- Push Switch Panels
- Rotary Switch Panels
- Snap Switch or Fool Proof Panels.

FEEDER PANELS AND DESK BOARD, LORD & TAYLOR, NEW YORK

METERING PANELS—

Not an ordinary metering panel. No loose plugs to get lost. The only metering panel with locking device so that an unauthorized person cannot alter connections after once set. No arcing, as metering connection is "dead" when switch is open.

The "METROPOLITAN" is the ONLY Metering panel having this feature. It is the ONLY SAFE PANEL. No other will give you half the satisfaction.

SPECIAL EQUIPMENT—We can build anything called for in your specification.

Delivery—The Best.

Prices—Write Us To-day.

TRADE **METROPOLITAN** MARK
ELECTRIC MFG CO.

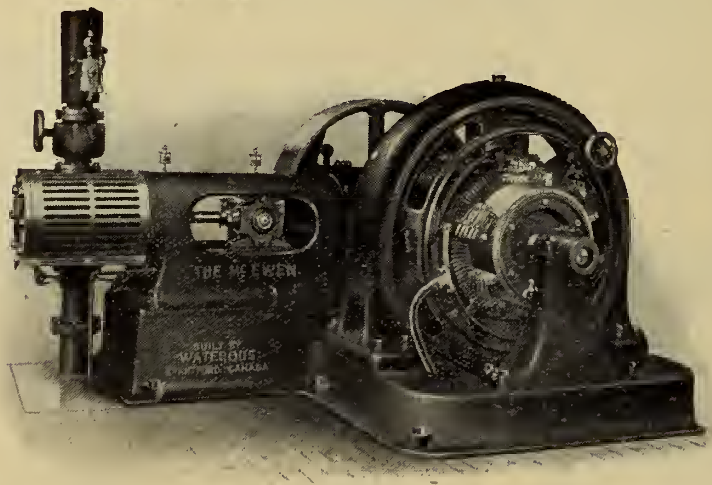
CANADIAN AGENTS:

ECONOMY ELECTRIC CO.

Bank of Hamilton Building **Yonge and Gould Sts., TORONTO**

McEWEN ENGINES

For the Isolated Plant



The McEwen High Speed Automatic Engine in your engine room is your best guarantee of continuous satisfactory service.

There are no shut-downs because "something has gone wrong on the transmission line."

Economical operation and the ability to be on the job every working day in the year, has placed the McEwen in hundreds of isolated plants in this country.

Ask for our list of Canadian users. It is the best selling argument we can show you.

The Waterous Engine Works Co., Limited BRANTFORD, CANADA

When you want a suit of clothes you go to your tailor don't you? — well then

isn't it reasonable to believe that when a housewife wants an electric washing machine she will go to the electric dealer for it. *Of course she will.*

And every housewife who has electricity in her home will buy a good electric washer.

"White Dove" Electric Washer

is one that every housewife will be proud of. Let her see it once and she will not be content until she has one in her home.

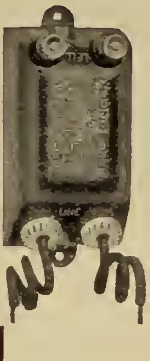
Every White Dove Washer is guaranteed to give lasting satisfaction, each machine being rigidly tested before leaving our factory.

You can't go wrong on stocking the White Dove.

Get particulars of our special Central Station proposition.

THE WHITE DOVE WASHER CO., Cobourg, Ont.

Are Your Customers Satisfied?



Are they satisfied with the continual annoyance of "Doorbell out of order," with the constant expense of battery renewals? It is so unnecessary. The

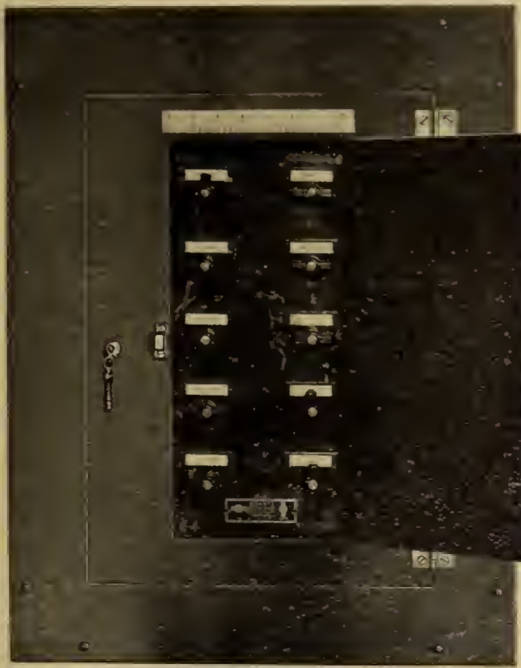
THORDARSON BELL - RINGING TRANSFORMER

operates door-bells and other signals from the lighting circuit. It is absolutely trouble-proof—no repairs and no maintenance expense. Investigate the Thordarson, the only complete line of low-voltage Transformers.

Write for Details

Thordarson Electric Mfg. Co.

503 S. Jefferson St. - Chicago



SAFETY PANEL

KRANTZ

Safety Panels
Panel Boards
Metering Panels
Knife Switches
Switch Boards

Of standard and special design for all requirements.

OUR ENGINEERS ARE AT YOUR SERVICE.

May we send you our Bulletins?

THE CANADIAN KRANTZ ELEC. & MFG. CO., LTD.

67-71 Adelaide St. West
TORONTO, ONT.

A Demand

The demand for a light, portable vacuum cleaner, inexpensive to buy and operate, has been filled by the

EUREKA Vacuum Cleaner

This electrically operated cleaner will sell to most customers on demonstration. The machine and tools are made of aluminum. The motor is specially made for the purpose, in our own factory and is absolutely guaranteed. The fan is made of steel, so that matches or other articles passing through cannot injure it. A brush which takes up lint, hair, etc., is furnished free with every machine.

Write for circular and dealers' proposition.

ONWARD MFG. CO.
BERLIN, ONT.

SAFETY FIRST

This is Assured by Using

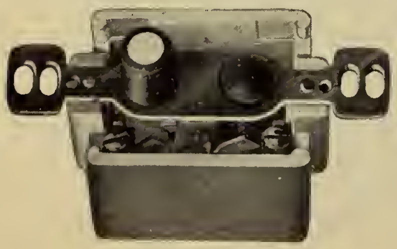
Monarch Specialties

Push Button Flush Switches

Single Pole, Double Pole, Three Way
With or without Brass Plates
Design and Construction Guarantees Durability, Accuracy in Operation.

Pull Chain Sockets

Supplied in Polish Brass, Brush Brass, Nickel Plate and Oxidize Copper Finish, From Stock, Other Finishes to Order.



If your Jobber does not stock Monarch Specialties write direct.

Monarch Electric Company, Limited
District of Montreal ST. LAMBERT, P.Q.

No. 21 Bulb, 50 C. P.

We are sole Canadian agents for

"ROYAL EDISWAN"

CARBON FILAMENT LAMPS

In the manufacture of the "Royal Ediswan" Carbon Lamp, the makers have spared no effort to perfect a product of superior quality and maximum efficiency.

Those among your customers who prefer the carbon filament lamp will find in the "Royal Ediswan" a satisfaction which comes only from a high-grade product.

Made in standard American bulbs, (also fancy bulbs) and built to standard specifications.

We are prepared to make prompt shipments on all orders—large or small.

Chapman & Walker, Limited

118-120 Richmond St. West, TORONTO
MONTREAL WINNIPEG VANCOUVER

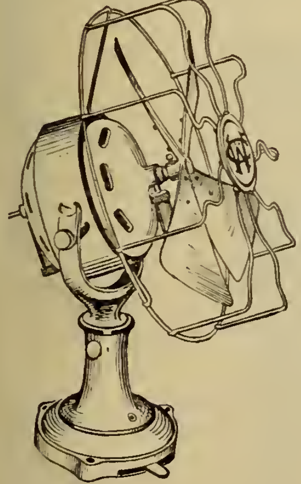
RIGHT NOW

Mr. Dealer is the time to place your

Fan Order

to make sure of future delivery.

The MARK of **QUALITY**



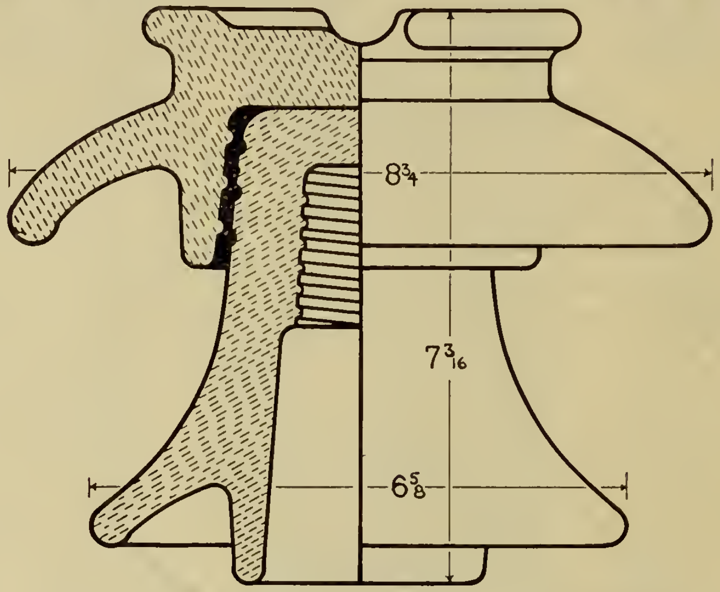
Oscillating Desk Fan.

Send for particulars of our "Special Future Delivery" contract form and Catalogue and make sure of getting your fan order delivered on time.

CHAPMAN & WALKER, Limited

118-120 Richmond St. W., TORONTO, ONT.
VANCOUVER MONTREAL
WINNIPEG—C. L. Trimingham, 206 Nanton Bldg.

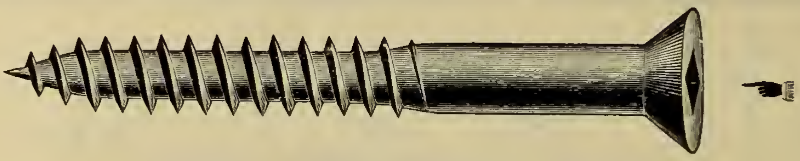
CANADIAN INSULATORS



Number	133
Line voltage	30,000
Test voltage	100,000
Rain test	65,000
Leakage distance	17¾-in.
Pin hole	1⅜-in.
Net weight	10½-lbs.
Packed weight	12-lbs.
No. per crate	6

The Canadian Porcelain Company, Limited

HAMILTON, - CANADA



SEE
THAT
SQUARE
HOLE

PAT. FEB. 2, 1909

ROBERTSON SOCKET HEAD
WOOD SCREWS

This new socket screw can effect a wonderful saving of time and material especially in electrical wire and fixture erection, etc.

They are used by simply placing the screw on the driver and then you may reach out at arm's length and drive it in with one hand. For overhead work or work between joists or under flooring it is invaluable.

Samples and Prices on Request

The P. L. Robertson Manufacturing Co., Ltd.

Milton — Ontario

The Ideal Power Plant

PLANTS NOW SUPPLIED OR ON ORDER
Plants Working*
*Town of Rapid City, Man.
* “ Russell, Man.
* “ Grenfell, Sask.
* “ Langham, Sask.
* “ Gull Lake, Sask.
“ Hanley, Sask.
* “ Wadena, Sask.
* “ Outlook, Sask.
* “ Herbert, Sask.
* “ Strassburg, Sask.
*The Leader Pub Co., Sask.

For Town Electric Lighting, WaterWorks or Sewage Disposal

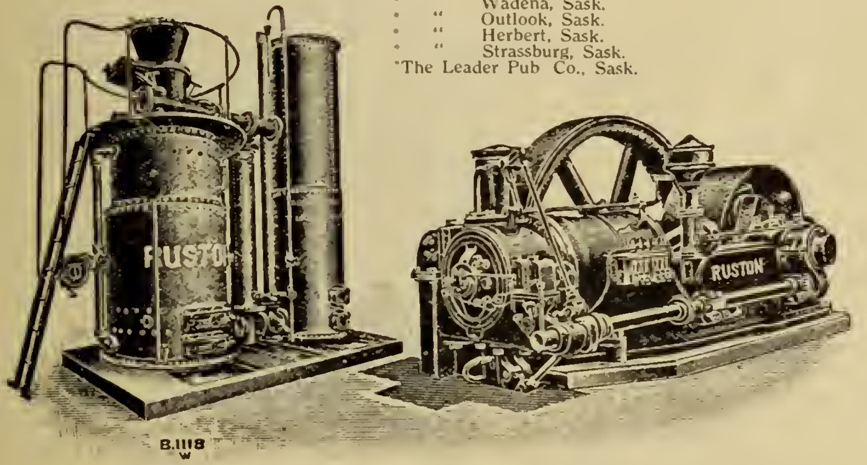
For Economy, Reliability, Ease of Cleaning Without Stopping the Plant, Clean and Cool Gas, Simplicity, and for Generating Electricity there is no Plant like the—

Ruston

Suction Gas Engine and Producer

For Anthracite, Coke and Charcoal

Patent Producers for using all kinds of Wood Refuse—as Wood Blocks, Bark Chippings, Sawdust, Etc.



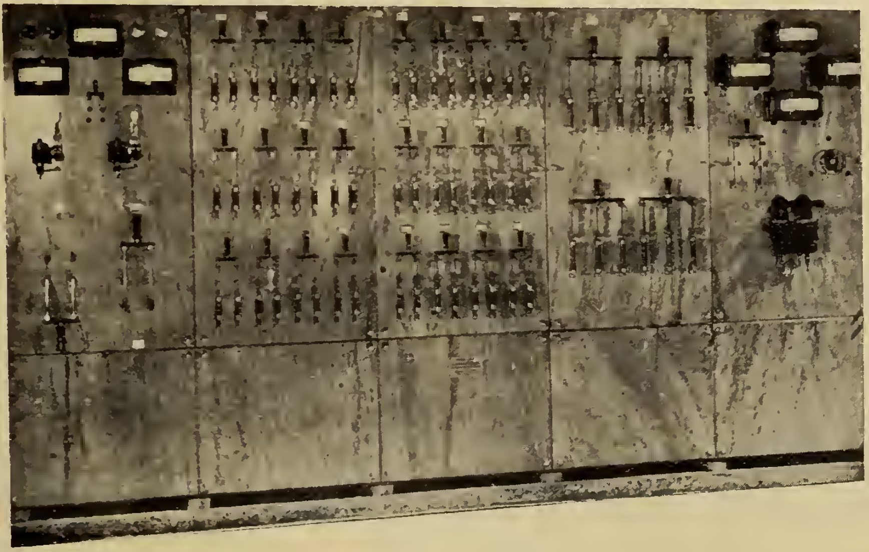
Ruston Suction Gas Producer for Anthracite and Ruston Gas Engine.

British-Canadian Engineering & Supply Co., Ltd.

122 Phoenix Block, Winnipeg, Manitoba

“DEVOE” MEANS QUALITY

Panels, Switches, Switch-Boards built to any specification



An examination of “DEVOE” Standard Panels, Switches and Switchboards will convince you they are the best made.

We specialize in Switch Boards.

THE DEVOE ELECTRIC SWITCH COMPANY

Office and Factory 157 Craig Street West, Montreal, Que.

Frank G. Scofield, Ontario Sales Representative, Lumsden Building, Toronto, Ontario

The gathering of the clans

"On to Toronto!"

YOU have doubtless noted with gratification the great movement for honesty and square dealing which is revolutionizing American and Canadian business methods. Our goods, our salesmanship and our advertising are being cleansed and vitalized by the the spirit of truth and sincerity.

As a result we see a growing public confidence in manufactured products and their advertising—a confidence which, if preserved and fostered, will decrease our costs, increase our profits, and become a business asset of incalculable value.

Foremost in the fight which has brought about this revolution stand the Associated Advertising Clubs of America, whose emblem is shown above. If you are a business man, interested in the manufacture, distribution, or selling of commodities of of any nature, you should attend the Tenth Annual Convention of the A. A. C. of A. at

TORONTO

June 21-25, 1914

At this Convention you will hear the inspiring story of the manner in which these tremendous reforms are being effected. More than this, you will hear the problems of distribution, merchandising, salesmanship and advertising discussed by able and successful business men in a series of open meetings.

These meetings will cover the questions of chief interest to the 10,000 business men comprising the 140 clubs of the A. A. C. of A.—*your own* problems included.

EDWARD MOTT WOOLLEY the famous writer on business topics, has written a booklet entitled "*The Story of Toronto.*" This booklet describes in a forceful, intensely interesting manner, the wonderful work the A. A. C. of A. are doing for clean advertising and square business methods, and the significance and importance of the Toronto Convention. This booklet will be sent free to all business men asking for it on their business stationery—together with detailed facts as to the convention programme and rates for accomodations.

Address Convention Bureau

Associated Advertising Clubs of America

TORONTO CANADA

A New Electric Range—Type R

The Canadian General Electric Company, Limited, offers a new range of remarkable efficiency, the result of years of research.

The chief reason for this high efficiency is the use of an entirely new discovery in heat insulating material—exclusively in the C-G-E range. The thermal resisting property of this new insulating substance is higher, and the thermal lag is less, than that of any material heretofore used.

The maximum connected load of the new range is only 3600 watts, compared with 6300 watts of the present types of ranges (like the Type D-40)—this, in addition to its greater cooking capacity (for 15 persons). The maximum demand, however, in cooking a long series of menus was not over 2600 watts.

Note the cooking compartments, individually heated and insulated, so that practically all the heat goes into cooking.

The hot plates are not only quick heating, but also insulated individually.

All metal parts are non-oxidizing.

The quality of material, construction and finish gives this new range a very handsome appearance—making it an ornament to any kitchen.

The equipment of the Type R-1 Range, now ready, is as follows:

Two quick heating, insulated hot plates, each 1000 watts high, 250 watts low.

Three insulated vegetable cooking compartments, each 200 watts.

One insulated oven, 18 x 18 x 12 inches, 1000 watts high, 250 watts low.

One radiant heat broiler (in top of oven).

Three aluminum utensils for cooking compartments.

Metal construction throughout, the exterior being finished in Wellsville Blue and "Gun Metal" (Baurbarff).

Our nearest district office will gladly furnish full particulars.

CANADIAN GENERAL ELECTRIC CO.

LIMITED

Manufacturers of Electrical Apparatus and Supplies
for Railway, Light and Power Purposes

Head Office: Toronto. District Sales Offices: Montreal, Halifax, Ottawa, Cobalt, Porcupine, Fort William, Winnipeg,
Regina, Saskatoon, Calgary, Edmonton, Nelson, Vancouver, Victoria, Prince Rupert

"FORTITER" FANS

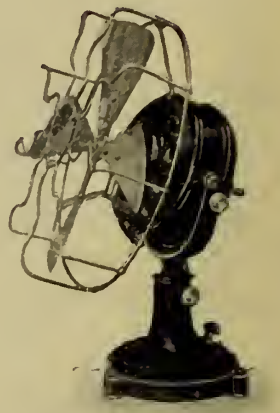
Now is the Time

Oscillating Fan

to place your orders for Fans and to display them in your show window.

We can give you prompt shipments and good prices.

Send us your enquiries or ask our representative to call and discuss our unique proposition.



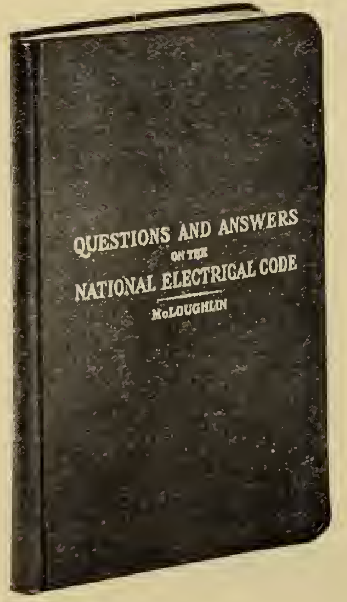
Swivel and Trunion Fan

Canadian Union Electric Company, Limited

Head Office, 130 Wellington Street West, TORONTO, Ont.

Also at, 705 Unity Building, 46 St. Alexander Street, MONTREAL, Que.

You Can Interpret the Code Instantly with McLoughlin's



Questions and Answers
on the
National Electrical Code

It tells at once the answer to the questions on code requirements.
Contractors, electricians and wiremen write us that it hits the mark for them. It saves them time, trouble and real money.
Every question is carefully indexed so that you can locate the fact you are after instantly.
Contents—There are nine main divisions: Generators, Transformers, Outside Works, Signaling Systems, Lighting, Inside Works, Electric Railway Systems, Marine Work.
Tables—Section 9 has 32 tables. They give in convenient form for ready reference: Capacities of wires; Wire requirements for all classes of work; Insulation Tests; Requirements for Conduit Wires; Flexible Cords; Fixture Wires; Theatre Cables; Elevator Cables, etc., etc.
The latest rules for Resuscitation are included.

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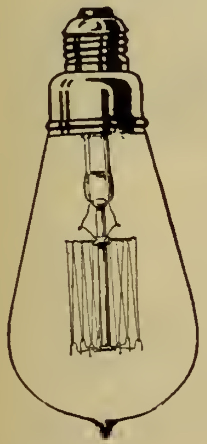

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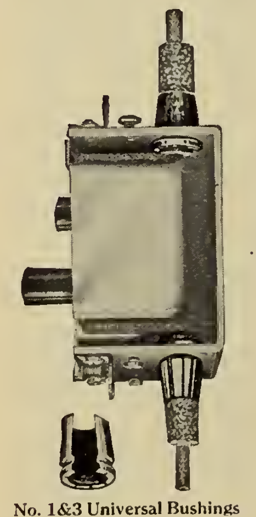

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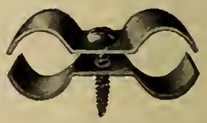

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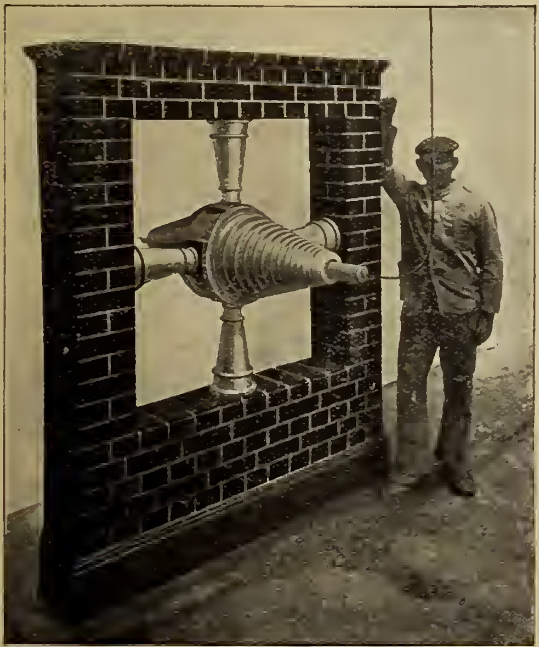

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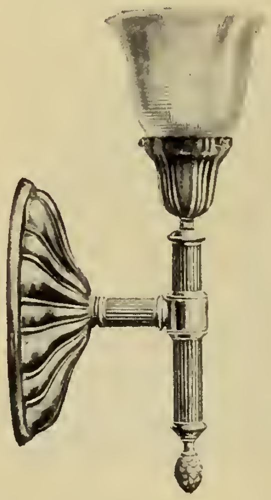

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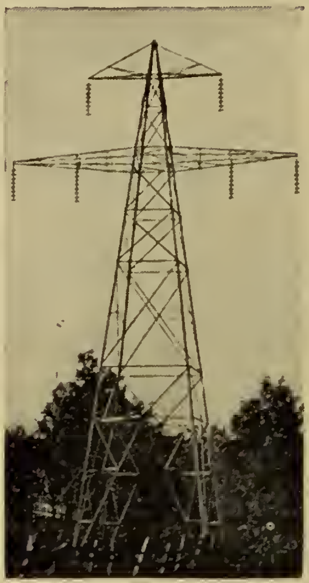

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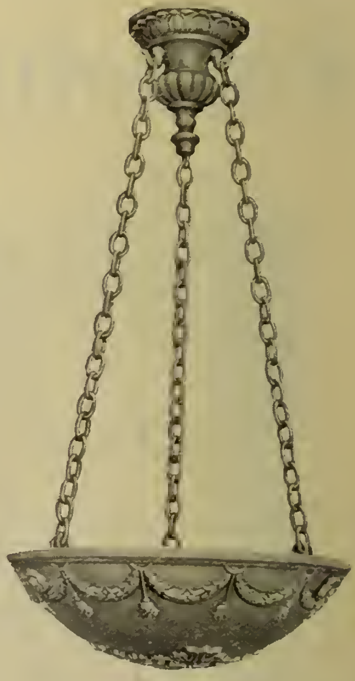

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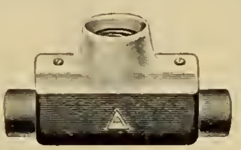

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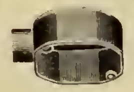

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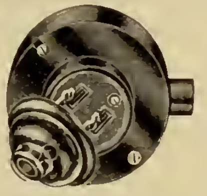

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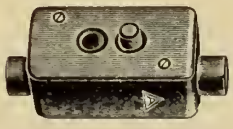

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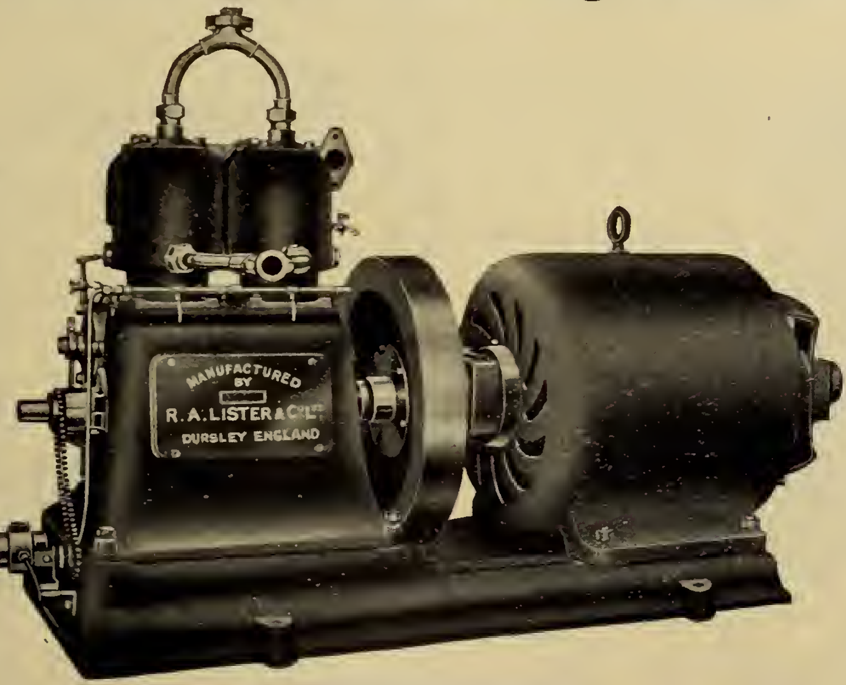

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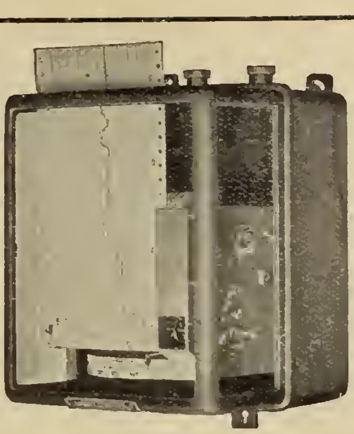

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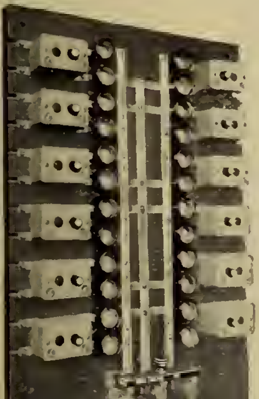

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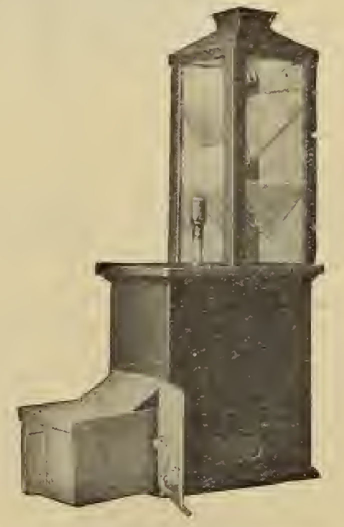

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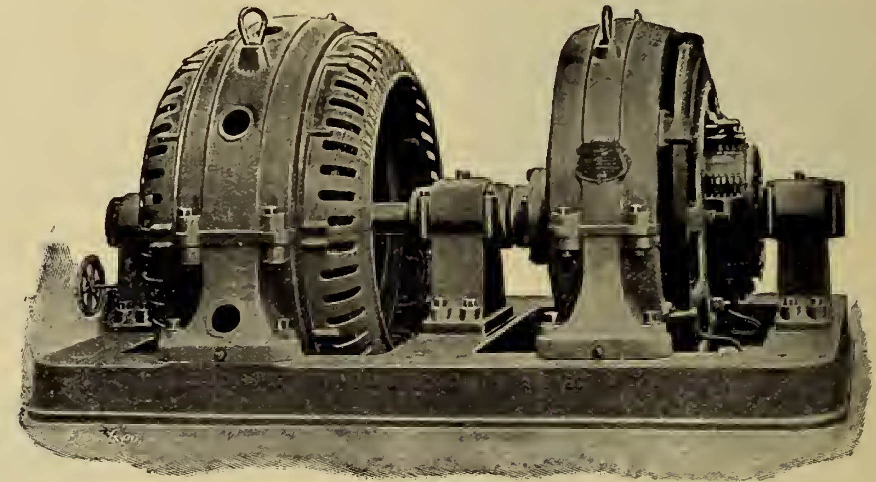

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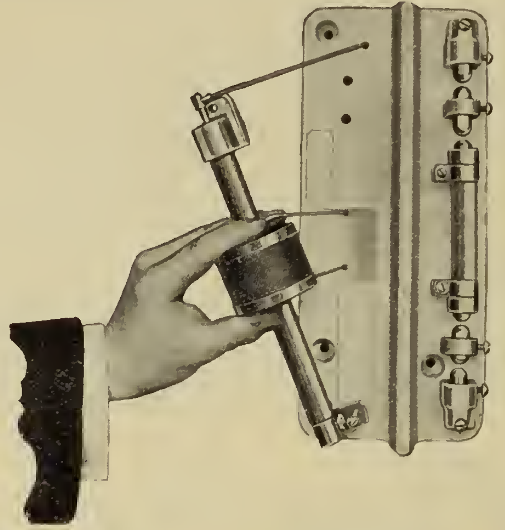

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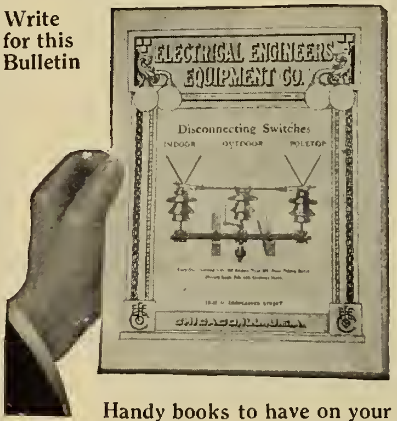

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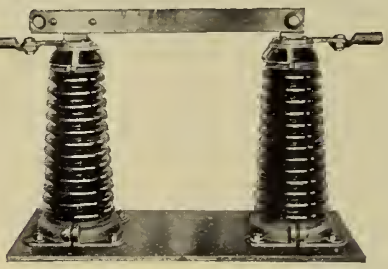

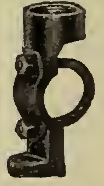

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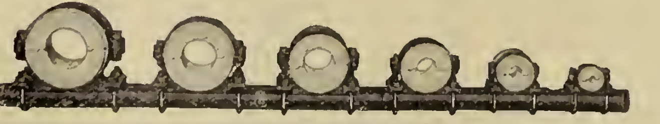

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Generation, Transmission and Application of Electricity

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Subscribers are requested to promptly notify the publishers of failure or delay in delivery of paper.

Vol. 23 Toronto, May 15, 1914 No. 10

Ugly Power Buildings

The Electrical News feels that it is not entirely without its province in calling the general attention of its readers to the inartistic style of building for power house and sub-station purposes that is being erected, for the most part, all over Canada. We make this reference with all due recognition of the necessity of keeping the cost of these buildings as low as possible, having in view satisfactory financial results. We do not suggest that the utilitarian side of such a plant be sacrificed to its artistic design, but it is very evident that the artistic has been made, in a great many cases, entirely subservient to the useful side of the station, when the addition of a few dollars, or perhaps even without this addition, a building which might have been a pleasure to the eye and a credit to the community has been made to stand out merely as a rough block of homely cement or brick work.

The trouble very probably lies in the fact that art and electrical power stations are two things never associated either in the mind of the engineer or the layman. Yet, what is more beautiful than the interior of a well designed, well equipped, and well kept electric station. Why then should the outside be ugly? Is there any single reason to justify the majority of the unsightly power plants one sees scattered throughout the length and breadth of our Dominion?

In this connection we have just stumbled across a little station which appeals to us as having been the work of a man who appreciated, to some considerable extent, his duty to the community in which he lives. In Clayburn, B.C., which even in the West has not yet aspired to the name of city, the operating company have built a little sub-station, without any additional cost, which makes one wonder some other stations have ever been allowed to stand. Doubtless the idea contained in this one is not perfect from an artistic point of view, but it certainly shows an appreciation of the requirements of the case and, as we said before indicates a patriotic interest in the general appearance of the town which this plant is designed to serve. A photograph of this sub-station is shown on another page of this issue along with a brief description of the plant. It will be seen that the sub-station is of very simple design, a bungalow type. Doubtless it could be improved in appearance, but there are few operating companies in Canada in a position to throw stones at it. We believe this is a step in the right direction and we are quite sure that our readers will agree with us that the sooner more attention is paid to the artistic side of our electric buildings the better it will be for the communities they serve individually. From every other point of view electricity, both in its generation and application is educative and refining in its tendencies. Is it not an anomaly then that electric buildings should be the least artistic of all our public structures?

Transit Facilities

An interesting topic and one of great economic importance at the forthcoming International Conference on City Planning will be the improvement of rapid transit facilities in our growing cities. A paper on "Provision for Future Rapid Transit: Subway, Elevated or Open Cut and their Influence on the City Plan" will be delivered by J. V. Davies, Consulting Engineer, Brooklyn Rapid Transit Company, and will be followed by another paper on "Rapid Transit and the Auto Bus" by John A. McCollum, Assistant Engineer, Board of Estimate and Apportionment, New York City. The positions these men occupy are a guarantee that they are well qualified to speak on transit problems, and their addresses will be awaited with much interest by those concerned with municipal affairs.

The transit problems of the present day have been made difficult by short-sighted city-planning in the past. How frequently do we see towns whose central, business streets are narrow and congested, while the outlying, residential sections have roadways that are broad and spacious! How universal in our large cities is the mechanical rule-of-thumb lay-out of streets in checker-board array, disregarding topography and natural routes of travel! The people of a generation ago can hardly be blamed for not foreseeing the tremendous development of electric traction and automobile traffic that has taken place in the last quarter of a century, but we of to-day are very stupid to go on planning our new cities on the model of the old. The building of skyscrapers is adding to the congestion in the centres of our cities and multiplying our traffic problems in the same ratio that it increases the population on a given area.

In connection with transit facilities, civic foresight must take heed of the franchises, contracts, and vested rights which public utility companies may be suffered to acquire. A franchise may confer a monopoly, but this monopoly should be carefully controlled. Only too seldom are public rights properly safe-guarded when granting privileges to large companies. The cities are not alone to blame. For example, legislatures may confer charters upon railway companies giving them the right to locate their lines where they please and perhaps to destroy the most carefully considered city plan because they are not amenable to municipal control. A similar observation applies to telephone and telegraph companies. The whole question of the granting of franchises and of the protection of public interests in relation thereto is a question that urgently requires the thoughtful attention of our public men.

Western Canada Power

Some interesting statements are published in the annual report of the Western Canada Power Company, Limited, by Mr. C. H. Cahan, president of the company. This power company has felt the pinch of the past twelve months as a result of the general unfavorable industrial conditions, and it is pointed out that the development of the company has been set back from twelve to eighteen months which means, presumably, that proposed installation of electrical equipment will be delayed approximately that length of time. The two units already installed by this company have been operating without mishap and though they have only a rated capacity of 9,000 kw. each, the company have a connected load of 30,000 h.p. The largest customer is the B. C. E. R. Company who are now taking something over 6,000 h.p. and who will eventually take, under their contract, up to 40,000 h.p. The Puget Sound Traction, Light & Power Company are taking 6,600 h.p. and the Western Canada Power Company have a further connected load in light, heat and industrial power of 15,500 h.p. During the year 1913 the power house generated 55,000,000 kw.

The Western Canada Power Company originally planned to utilize the waters of the Stave River at two points a few miles apart. The first of these was calculated to operate four 9,000 kw. units and the second to develop practically the same amount. The annual report states, however, that instead of constructing one dam 165 feet high for the second development it has now been decided that more economical development can be made by building two power houses for a 65-foot head and each capable of operating a 30,000 kw. capacity. It is further stated that preliminary designs and estimates show that the whole development can be made at a cost of from $55 to $60 per h.p. If these estimates are realized it will mean that the Western Canada Power Company's total capacity at the three points on Stave River will be 96,000 kw.

Estimates are given in the annual report of the probable earnings for the next three years. These appear to be conservative but their realization will depend largely upon industrial conditions.

Toronto's Lower Rates

After considerable discussion the matter of rates for the Toronto Hydro-electric system has been settled by a final order from the Ontario Hydro-electric Commission that the rates be lowered from June 1st. The system of charging which in Toronto has not been quite in uniformity with the standard system laid down by the commission is now made to conform exactly with other municipalities. The rates beginning June 1st represent a reduction of approximately 10 per cent. all round and are as follows:—

Power Rate:—$1.00 per month per horse-power of connected load, or maximum demand of such load, where a suitable maximum demand meter is installed. In addition a consumption charge of 1.5c per kw.h. for the first fifty hours' use of the maximum demand; 1c per kw.h. for the second fifty hours' use of the maximum demand and 0.15c per kw.h. for all additional consumption. These base rates are subject to the following discounts: Class A (24-hour unrestricted use) no discount; Class B (24-hour restricted use) 10 per cent. discount; Class C (10-hour unrestricted use) 10 per cent. discount; Class D (10-hour restricted use) 33 1/3 per cent. discount. Monthly bills subject to a further prompt payment discount of 20 per cent.

Domestic Lighting:—4c per 100 sq. ft. of floor area, plus a consumption charge of 3c per kw.h. Prompt payment discounts of 20 per cent.

Commercial Lighting:—6c per kw.h. for the first thirty hours' monthly use of installed capacity plus 3c per kw.h. for all additional consumption. Prompt payment discount of 20 per cent.

Street Lighting:—A reduction of $1.00 per lamp for each 100 watt lamp used for the purpose of street lighting, for both single and cluster lights. This makes the future price $8.00 per 100 watt lamp.

Electric Vehicle Association Growing

At the time of the last convention in Chicago the Electric Vehicle Association had 437 members. At present writing over 650 members are enrolled, an increase of over 200 members, or at the rate of about 600 a year. It is hoped that by the time of the next Convention, to be held in Philadelphia during October (the exact date to be announced shortly) that the one thousand mark will have been reached.

It will be interesting to note also that last year only two sections—New England and Chicago—existed. Now, sections are organized in New England, Chicago, Philadelphia, Washington, Cincinnati, and San Francisco—the last two sections being very recently added. It is expected that by the time of the Philadelphia Convention the present six sections, representing a growth of 300 per cent. in about six months, will have increased to between ten and fifteen sections.

These increases in membership and section formation, which permits of very direct, constructive work in various localities, is indicative not only of the strength of the Electric Vehicle Association, but the extremely healthy condition of the electric vehicle industry as a whole.

Municipal Lighting System

At the suggestion of the Montreal controllers, Mr. Parent, the superintendent of lighting, will prepare a report on the cost of installing a plant for 500 street lights for the central district. The question arose out of a dispute between the city and the Montreal Light, Heat & Power Company as to the charges to be made for new lights on St. Catherine Street and Bleury Street, where the underground conduits have been laid. The company ask $156 for each lamp, including equipment; $143 per lamp, the city supplying a portion of the equipment; and $83 if the city supplies the entire equipment. The present price is $72.70 per lamp, but the company deny that they are liable to supply lights by the underground conduit distribution at the price fixed under the present contract. This is for overhead service, and the company contend that the city must pay a fair differential for underground service, the latter being relatively more costly than overhead service. In addition the capital charges involved will have to be written off in six years. The company are willing to arbitrate the matter in a friendly way. The city on the other hand repudiate liability for a higher charge except where the use of a special lamp will result in additional expense.

G. T. P. Telegraphs and Telephones

Mr. A. Bruce Smith, manager of telegraphs of the Grand Trunk system, was present at the driving of the last spike on the Grand Trunk Pacific, and also superintended the completion of the telegraph wiring. The system is now built between Port Arthur and Prince Rupert, but there is at present only a commercial service as far west as Prince George. Commercial messages will be accepted in a short time through to the Pacific Coast. Wires are now strung along 2,200 miles of main line, exclusive of branch lines, in Manitoba, Saskatchewan, Alberta and British Columbia. Nearly six thousand miles of copper wire have been erected. In addition to the telegraph service the Grand Trunk Pacific is making rapid headway with the installation of the Selective Telephone Train Despatch System.

Electricity in Clay Products Plant

The Clayburn Company, of Clayburn, B.C., manufacturers of all classes of clay products, including all kinds of fire clay goods, have recently completed electrifying their entire plant.

The factory is situated about a mile from the C. P. R. and B. C. E. R. and the clay and shale deposits are 3½ or 4 miles from the factory. The Clayburn Company have 6 miles of railroad including side tracks.

Their original power equipment consisted of a 150 h.p. steam engine for factory drive, a 15 h.p. engine for fan drive, and two steam locomotives. It became apparent some time ago that this equipment could not meet the requirements and as the Western Canada Power Company were extending their lines in this direction the managing director of the Clayburn Company, Mr. J. B. Millar, recommended the electrification of the plant. A temporary sub-station was built and a few motors installed which proved such a success that last summer a permanent sub-station was erected in place of the old one. The new one is built in bungalow style, Fig. 1, clinker brick outside, and lined with different colored pressed brick tastefully arranged. The floor is of cement, smooth finished, and the ceiling pressed steel which makes the building entirely fireproof. The inside dimensions of the sub-station are 33 ft. by 22 ft.

The Western Canada Power Company's 12,000 volt line is led to a pole at the rear of the sub-station and brought into the station under ground, using submarine cable. The current passes through knife switches to a hand-operated oil switch mounted on a slate panel, to 12,000 volt bus-bars; thence to three single-phase 167 kw. C. G. E. transformers, where it is stepped down to 2,300 volts and brought under the floor, through an oil switch, and delivered to the Clayburn Company's bus-bars.

The switchboard consists of 8 slate panels, block marine finish. Panel 1 controls the W. C. P. Company's 2,300 volt outgoing line to supply house lighting.

Panel 2, the W. C. P. Company's 2,300 volt feed to the Clayburn Company's bus-bars.

Sub-station of Clayburn Company, Clayburn, B.C.

Panel 3, the Clayburn Company's 2,300 volt feed going to three 50 kv.a., 2,300 to 220 volt, transformers located on a rack just outside the station, shown in Fig. 1; a 220 volt service is then brought back to panel 8 through a 600 amp. 4-pole knife switch and distributed to four 3-pole knife switches; one of these switches controls a circuit leading to a 50 h.p. Allis-Chalmers motor which drives a soft mud plant for making common brick; this plant has a capacity of 33,000 bricks per day of 10 hours. Another of these switches controls a circuit leading to a 40 h.p. Allis-Chalmers motor which drives a fan 24 hours per day. Another switch controls a circuit leading to a 20 h.p. Allis-Chalmers motor driving a fan 24 hours per day. The fourth switch controls a circuit having three 5 h.p. motors; one motor drives an air compressor, compressed air being used for the factory whistle and cleaning out the motors; another 5 h.p. motor drives an elevator for handling coal and the other motor is connected to an emergency pump to be used in case of fire. On the same panel there are 4 double-pole switches for lighting circuits.

Panel 4 controls the Clayburn Company's 2300 volt circuit leading to a 200 h.p. Allis-Chalmers motor which replaced the 150 h.p. steam engine for factory drive. The capacity of this factory is 50,000 bricks per day and consists of 3 dry pans, 2 dry press machines, pug mill, auger machine, wire cut and repress machine, as well as elevators, shafting, etc. There was considerable trouble keeping them all going with the steam engine but no trouble has been experienced since the motor was installed. In making press brick it is necessary for the dies to be heated; steam was originally used for this purpose but the company now use Can. Gen. Electric heating units. Panel 5 is a spare to take care of future extensions.

Interior Clayburn Company's sub-station.

Panel 6 controls a 2,300 volt lead to a 125 kw. Westinghouse motor-generator set which generates power to drive a 10-ton Westinghouse-Baldwin locomotive. The original steam road has been electrified and the two steam locomotives have been replaced by one electric. It is found that one electric locomotive will give about twice the service that one steam locomotive did. Panel 7 controls the d.c. side of the motor-generator set.

Armoured cable was used in all circuits in or out of the sub-station and all leads are under ground.

There seems to be doubt in the minds of some manufacturers as to the success of electric drive in the brick making industry but Mr. J. B. Millar has proof at Clayburn that electricity for brickmaking is a success from any point of view.

Canadian Electrical Association Convention

The annual convention of the Canadian Electrical Association will be held this year in Montreal on June 24, 25 and 26. The headquarters of the convention will be in the new club rooms of the Canadian Society of Civil Engineers, Mansfield Street. At a recent meeting of the executive branch committees were formed including a convention committee of Montreal men, a committee in Toronto to co-operate with them, a papers committee, etc.

Keokuk Transmission Lines

The power of the Mississippi River Power Company, one of the largest hydro-electric plants in the world, is transmitted for the most part to St. Louis, a distance of 144 miles, at 110,000 volts. There are, however, several branch lines tapped off the higher voltage lines for serving districts along the way. These include 29 miles of 66,000 volt line; 28 miles of 33,000 volt line and 42 miles of 11,000 volt line. Some interesting details in connection with these lines are given herewith.

The high tension line to St. Louis is a double circuit steel tower line built on a 100-foot private right-of-way. The normal span is approximately 800 feet and the longest, crossing the Missouri River, is 3,180 feet. The towers are all of the four-legged square base construction, the standard type having a total height of 79 feet, a base measurement of 20 feet square and a weight of 6,800 lbs.

Strain towers are used at all angles on both sides of railroad crossings and for approximately every tenth tower on tangents. Strain towers have a total height of 74 feet, base 24 ft. x 24 ft. and a weight of 10,500 lbs. The conductors are dead-ended at all strain towers.

The line conductors consist of a nineteen strand medium drawn copper cable having an area of 300,000 circular mils. The three wires of each circuit are arranged in tandem at elevations of 50, 60, and 70 feet respectively above the ground The two circuits on opposite sides of the towers are separated by about 18½ feet, the top wires being slightly closer together than the bottom wires. The cables have an ultimate strength of 14,000 lbs. which gives a factor of safety of 2 under the supposed worst load conditions, which are estimated to be a one-half inch coat of ice, a sixty mile wind and 0 deg. F. For an 800 foot span this works out to a load of not more than 7,000 lbs.

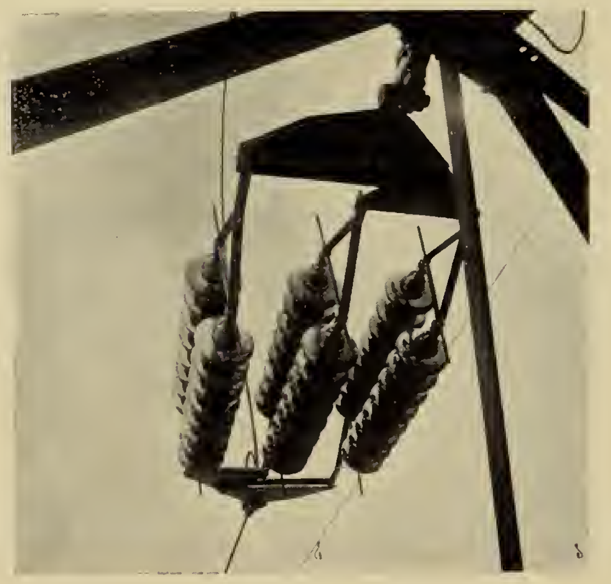


Fig. 1. Strain insulators at Missouri River crossing.

The suspension insulators on the standard towers consist of series groups of seven 10-inch disks. On anchor towers each conductor is held by two series groups in parallel, each group consisting of eight ten inch disks. The suspension insulators were subjected to a rain test of 330,000 volts and to a dry test of 440,000 volts. The corona voltage of the line is approximately 150,000 volts which gives considerable margin above the operating voltage of 110,000.

The ground wire is one-half inch diameter, seven strand, galvanized Siemens-Martin steel mounted on the apex of the towers.

All towers are provided with heavy reinforced concrete foundations. The foundations of the standard towers extend 6 feet below the surface of the ground and of the strain towers 8 feet below the ground.

The crossing of the Missouri River necessitates one span 3,180 feet and another 2,350 feet with a tower 235 feet high located on an island near the middle of the river. The conductor used on these long spans is a ⅝-inch, nineteen strand core of special high tension steel with an outer stranding of twenty No. 10 B. & S. hard drawn copper wires, making a total diameter of ⅞ inches. These conductors are fastened rigidly to the towers by a group of six parallel series insulators each consisting of eight 10-inch disks as shown in Fig. 1. This figure also shows the system of equalizing levers providing for dividing the strain equally among the six strings of insulators. The ultimate strength of each of these conductors is 52,000 lbs. and of the insulator banks 60,000 lbs. As the worst load conditions are calculated to be 24,000 lbs. this thus provides a large safety factor.

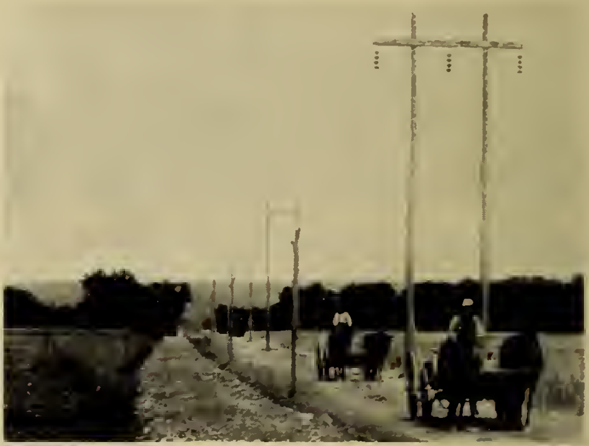


Fig. 2. Type of 66,000 volt wooden pole line.

Each of the two circuits has a capacity of 45,000 h.p. with a voltage drop of 10 per cent. and an energy loss of approximately 10 per cent.

The telephone line parallels the transmission line for the entire 144 miles. It is built on one side of the right-of-way and consists of two No. 8 telephone conductors, and a ground wire, mounted on 30-foot cedar poles spaced 125 feet. Houses for the patrol men are provided every 18 miles and telephone booths every four miles.

The 66,000 Volt Line

The conductors for the 66,000 volt line are supported on H-frame wooden pole structures spaced 300 feet. These are shown in Fig. 2. The structures consist of two cypress poles six inches in diameter at the top and 45 feet high, with wooden cross arms made up of two pieces 2-in. x 8-in. x 16-ft. Three No. 2/0 stranded copper conductors are supported in a horizontal plane as shown in Fig. 2 by four-disk suspension insulators. Two ground wires 5-16 inch diameter Siemens-Martin galvanized steel strand, are carried on the top of the poles. Two No. 8 copper clad telephone wires are supported on brackets on the sides of the poles.

The 33,000 volt lines consist of No. 2/0 stranded hard-drawn copper, mounted on pin type insulators, carried on 40-foot poles, spaced approximately 140 feet apart. A ½-inch galvanized steel strand ground wire is mounted on top of the pole and two No. 8 telephone wires are carried on cross arms below the conductors.

Kananaskis Falls Plant Completed

Interior Kananaskis Falls generating station.

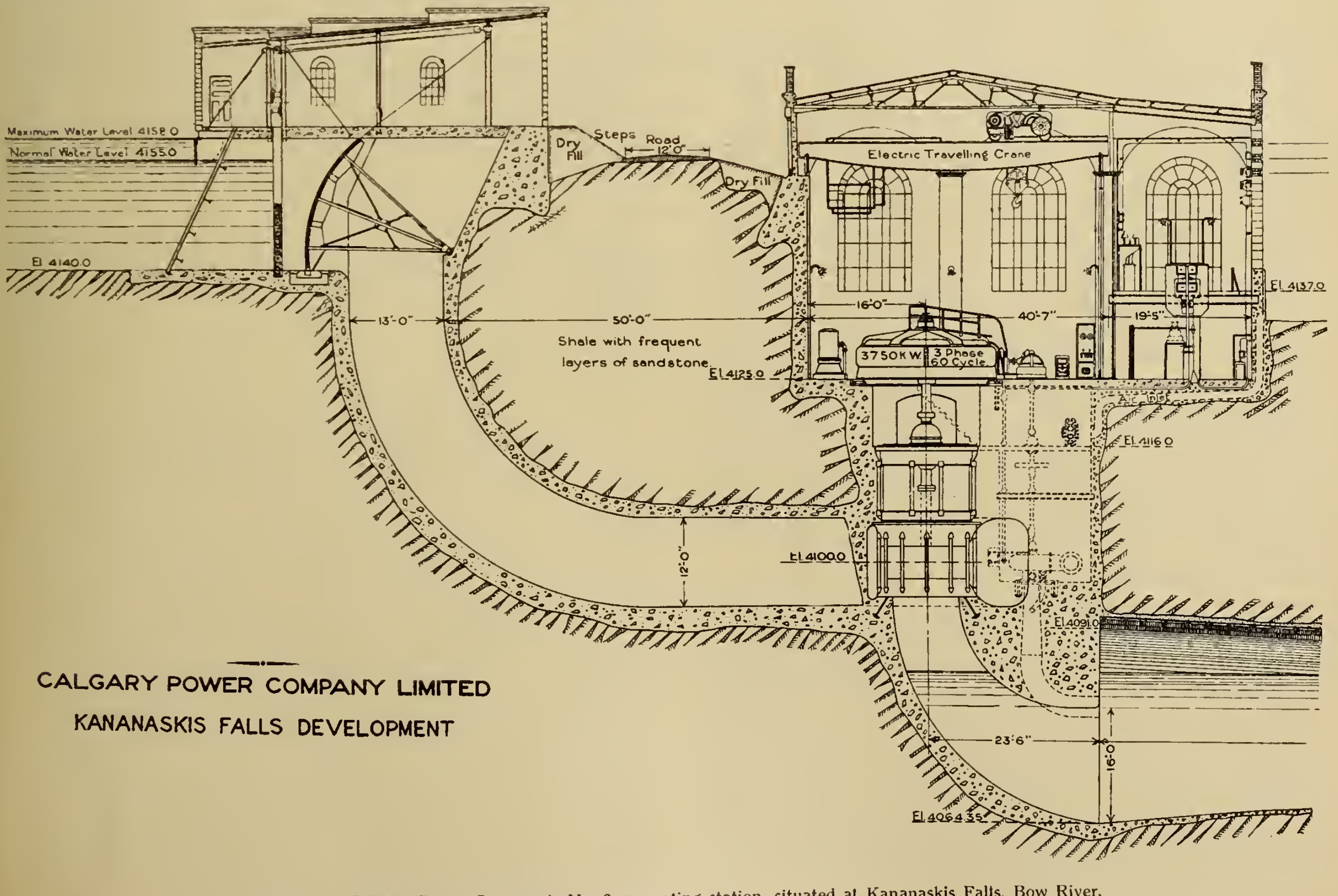
A few further notes and illustrations in regard to the Calgary Power Company's new generating station on the Bow River will be of interest to our readers.

It will be remembered that the Calgary Power Company have been building their second hydro-electric plant on the Bow River about 50 miles west of Calgary. The first development was at Horse Shoe Falls, the second about two miles up stream at Kananaskis Falls. At the Horse Shoe Falls where the full capacity is now installed there are four units with a total capacity of 18,000 h.p. Generation is at 12,000 volts which is stepped up to 55,000 volts for transmission to Calgary. Power is also supplied to Exshaw for cement and other manufacturing purposes at 12,000 volts.

The new Kananaskis station contains two units of approximately 6,000 h.p. each which brings the total of the two plants to 30,000 h.p. capacity.

General construction work and the first unit installation in the power house at Kananaskis being nearly completed about the middle of December last, the result of a year's labor was appreciated in the starting up of the first wheel and generator to the satisfaction of the company. When the concrete structure of the dam was entirely completed, the head water canal inlaid with concrete as far as necessary, and the head works ready for operation, stop logs were gradually inserted in the several sections of the dam by means of an electrically operated winch, the forebay raised to its ultimate elevation of 3155 feet above sea level, and the head-water filled the dam to its working depth of 15 feet The water flows through cleaning racks and enters the pressure tubes (of concrete) through four stop log sections, regulated by four tainter gates, two for each pressure tube, and raised by means of hand operated winches. Water enters each turbine from a small chamber, through wicker gates, and discharges into draft tubes (of concrete) and is carried through tunnels to the river below.

The hydraulic installation at Kananaskis Falls consists of two vertical type turbines, 5,800 horse power each, manu-

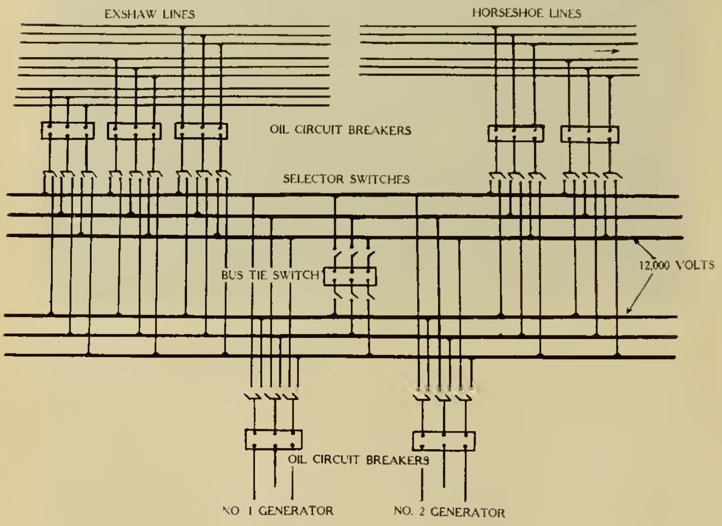

Maximum Water Level 4158.0
Normal Water Level 4155.0
El 4140.0
Steps
Road
12'0"
Dry Fill
Dry Fill
13'-0"
50'-0"
Shale with frequent layers of sandstone
El 4125.0
12'-0"
El 4100.0
Electric Travelling Crane
16'0"
40'-7"
19'-5"
3750 K.W.
3 Phase 60 Cycle
El 4137.0
Air Inlet
El 4116.0
El 4091.0
23'6"
16'0
El 4064.35
CALGARY POWER COMPANY LIMITED
KANANASKIS FALLS DEVELOPMENT

Section of Calgary Power Company's No. 2 generating station, situated at Kananaskis Falls, Bow River.

factured by the Canadian Allis-Chalmers, Limited, and supported by the Kingsbury bearing; the turbines are single runner wheels to operate at 164 r.p.m. They are direct connected to two vertical generators 4,250 kv.a., 12,000 volts, 60-cycle, 164 r.p.m., built by the Swedish General Electric Company. Turbines are controlled by Canadian Allis-Chalmers hydraulic governors, motor operated pressure pumps.

One turbo-exciter is installed, 75 kw., 220 volts, 600 r.p.m., and one motor-generator exciter of the same capacity, both Swedish General Electric. A 50-ton electrically operated crane is installed for the handling of heavy material.

On the main floor is situated all switching apparatus which consists of a main control board of eleven panels, vertical type, of dull finish slate, containing meters, relays and remote control devices, a station service board, a lighting panel and storage battery charging panel, all installed by the Canadian Westinghouse Company. On a gallery above the switchboard are erected the 12,000 volt buses and electrolytic lightning arresters, above which the five outgoing lines are run through the wall. Space is provided at one end of the main floor for a machine and workshop. The floor is inlaid with tile presenting a very pleasing appearance.



Wiring diagram, Kananaskis Falls station.

The transmission system has been designed for great flexibility. No. 2 plant is provided with two 12,000 volt busses, to either of which both generators can be cut in at any time. This station is also tied in with No. 1 station by two copper-aluminium circuits, either line to be closed in on either bus at pleasure. Power is transmitted to the Canada Cement Company at Exshaw over three 12,000 volt circuits which can also be cut in on either bus; so that electric power can be transmitted at any time from either or both stations to either Calgary or Exshaw or both. Voltage is stepped up in No. 1 (Horse Shoe Falls) plant from 12,000 volts to 55,000 volts for transmission to Calgary. There is no high tension transformer installation at Kananaskis Falls.

Hamilton Section C. E. A.

The Hamilton Section of the C. E. A. held its May meeting in the Section Room, Terminal Building, Thursday evening, May 7th. There was an attendance of 50, consisting of members and friends. The special feature of the evening consisted of a vaudeville entertainment under the subject of "Hooked Up" or "Landing a Customer." The act showed the lighting service of the Hamilton Electric Light & Power Company, tracing the contract and all the necessary work that it entails from the time the customer first makes application for light until the rendering of the bill. The dramatizing was a very good success.

Washing Machine Contest

The Electric Club of Chicago a year ago conducted an early summer advertising campaign which was designed to familiarize the public with the electric washing machine. This campaign consisted of advertising, direct-by-mail matter, and personal solicitation. As a premium they presented to the winner one of their electric washers.

The contest was for the best article describing the savings made possible by the use of an electric washing machine. The contest was open to all. Blanks were furnished the competitors as an aid in preparing their lists of savings. This plan showed spaces for estimating saving in wages, food and car fare for servants and washerwomen, labor, fuel, soap, wear and tear on clothing and materials washed, tearing out buttons, laundry damaged, laundry losses, cleaner's bills, time, space, damage from steam in the room, long boiling, health.

The idea is a good one for central stations to follow in that it tends to advertise and popularize the use of this or any other electric appliance. Some of the advantages given in the contest by the contestants were exceedingly forceful, not the least of which was contained in one letter which related that all the members of a certain household had contracted measles from a washerwoman. The winning estimate of savings for one year in a household of average size is printed below. At first sight it looks large, but if one compares the actual figures attached to any one item with one's actual experience it will probably be found that in many cases the figures are too low. This item of expenditure is, for the most part, one not treated in detail by the average domestic book-keeping department and probably runs into much bigger figures than is generally supposed.

Wages to servants and washwomen	63.00
Food and carfare to servants and washwomen	8.40
Labor	22.00
Fuel	6.30
Soap	4.50
Wear and tear on clothing and materials washed	13.50
Tearing out buttons	.60
Laundry damage, such as marks of iron rust, etc.	1.30
Laundry losses	2.70
Cleaner's bills	6.00
Time	37.80
Space	10.50
Damage from quantities of steam in the room	2.75
Long Boiling	1.00
Health	4.20
Total	$185.05

Montreal Suburban Extensions

In continuation of the electric lighting of the lakeside district, just outside Montreal, a contract is being carried out by Mr. W. G. H. Cam, Montreal, for the lighting—street and domestic—of Beaconsfield and Beaurepaire, from plans by Mr. G. W. Thompson. The lines will be 4½ miles long, and power will be supplied by the Montreal Light, Heat & Power Company, from the sub-station at Lakeside to a distributing station at Point Claire, and thence to a sub-station at Beaconsfield which will be built by the Beaconsfield Council. This sub-station will be constructed of brick and will contain a small transformer, panel board, etc The lighting system will consist of 100 6.6 ampere lights, 60 c.p.; tungstens will be installed at first, but will afterwards likely be changed to the nitrogen filled type. The poles will be 30 feet high, placed 125 feet apart, with a light on every alternate pole. There will be about 12 transformers, the highest capacity being five kw. The Canadian General Electric Company are supplying the electrical equipment.

Details of Brentwood Bay Steam Plant

From time to time, we have printed in the Electrical News brief reference to the electrical equipment at the Brentwood Bay steam plant of the B. C. E. R. Company, but we are glad to be able to give our readers a very complete detailed description of the whole plant covering not only the electrical side but the steam units and all the necessary auxiliaries. We are also reproducing a plan and section of this plant which may well be considered as representing at every point the highest standard of modern engineering efficiency.

The city of Victoria is the capital of the Province of British Columbia, and is finely situated at the southern end of Vancouver Island, in one of the most fertile districts of the Province. During the years 1910-1911, the rate of growth of this city was altogether abnormal, and in the spring of 1912 it became evident that the Vancouver Island Power Company, Limited, one of the subsidiary companies of the British Columbia Electric Railway Company, Limited, which supplies Victoria and its surroundings with electrical energy, would be compelled to increase the capacity of its generating plant with the utmost possible despatch.

The company had at that time in operation its hydro-electric plants at Goldstream and at Jordan River. The latter plant was placed in operation in the autumn of 1911, thus increasing the capacity of the system by 8,000 kw., but nevertheless, the load continued to grow at such a rate that this increase appeared to be inadequate to met the probable demands of the winter load. In such a limited period of time, further additions to the hydro-electric plants could not be made, and the installation of an auxiliary steam plant was, therefore, decided upon.

During the past few years, Messrs. C. C. Moore & Company of San Francisco, have installed a number of steam turbine units in Vancouver for the B. C. E. R. Company, and their work had been so expeditiously carried out that it was decided to award the contract for construction of the new steam plant on Vancouver Island to that firm, the contract being on a "cost plus fixed sum" basis. The electrical portion of the work was carried out by the company's forces.

After a careful investigation of the sites available for the plant, Brentwood Bay on Saanich Inlet was selected as the most suitable location. The new plant is thus about 12 miles north of Victoria, and in close proximity to the British Columbia Electric Railway Company's Saanich interurban railway. A very suitable site was obtained on this bay; there is an ample supply of water within easy suction limits for condensing purposes, and the water is of such depth that large oil tank steamers can deliver their cargoes with ease and safety. A construction camp, consisting of 40 canvas tents with the necessary cook houses, was built, and active construction work was commenced on June 1, 1912.

The Plant Site

The site of the plant was covered with a heavy growth of timber; this timber was cut and removed, the stumps were grubbed out, and the refuse burned. Great care had to be taken in burning the stumps to prevent the spreading of the fire to the surrounding timber.

The overburden at the site averaged about 2 feet in thickness, and amounted to about 3,500 cubic yards; the underlying rock was of an igneous nature, but it was badly shattered and weathered rapidly. The surface of the ground sloped up rapidly from the shore, and in order to keep the plant within suction limits, a considerable depth of excavation was necessary at the back of the building. The quantity of excavation amounted to about 27,000 cubic yards. On account of the difficulties involved at that time in taking in construction plant, a steam shovel was not used all excavation being done by cars and track. The cars were of 1 cubic yard capacity and were filled by hand.

The preliminary work was carried out by night and day shifts, and the contractors experienced considerable difficulty in securing the necessary labor, as work in Victoria was plentiful. Although the work was pushed as much as possible, the machinery began to arrive before the foundations were in place.

The Plant

The proposed ultimate development of the Brentwood Bay steam plant is 20,000 kw. The preliminary installation consists of two 2,000 kw. Allis-Chalmers turbo-generators, as much better delivery could be obtained on units of this size than on 5,000 kw. units. The 2,000 kw. units are so located in the middle of the turbine room that they can be replaced by 5,000 kw. units, if this course is found desirable. The location of the 2,000 kw. units is also arranged so that if these units are left in place, one 7,500 kw. unit can be placed on each side of the existing units.

The generators as well as the turbines were supplied by the Allis-Chalmers Company. Three-phase, 60-cycle current is generated at 2,300 volts, the speed of the units being 1,800 r.p.m. In addition to the steam driven units, two 500 kw., 600 volt d.c. generators direct connected to one 1,500 kv.a., three-phase, 60-cycle, 2,300 volt synchronous motor are provided.

A space is provided in the transformer room for three banks of three single-phase, 2,300/60,000 volt, 2,000 kv.a. oil insulated, water-cooled transformers. At present only one bank of transformers is installed, together with one spare transformer. For the 11,000 volt feeders, one bank of three 1,000 kv.a. oil insulated, water-cooled transformers is provided for stepping down from 60,000 to 11,000 volts.

Building

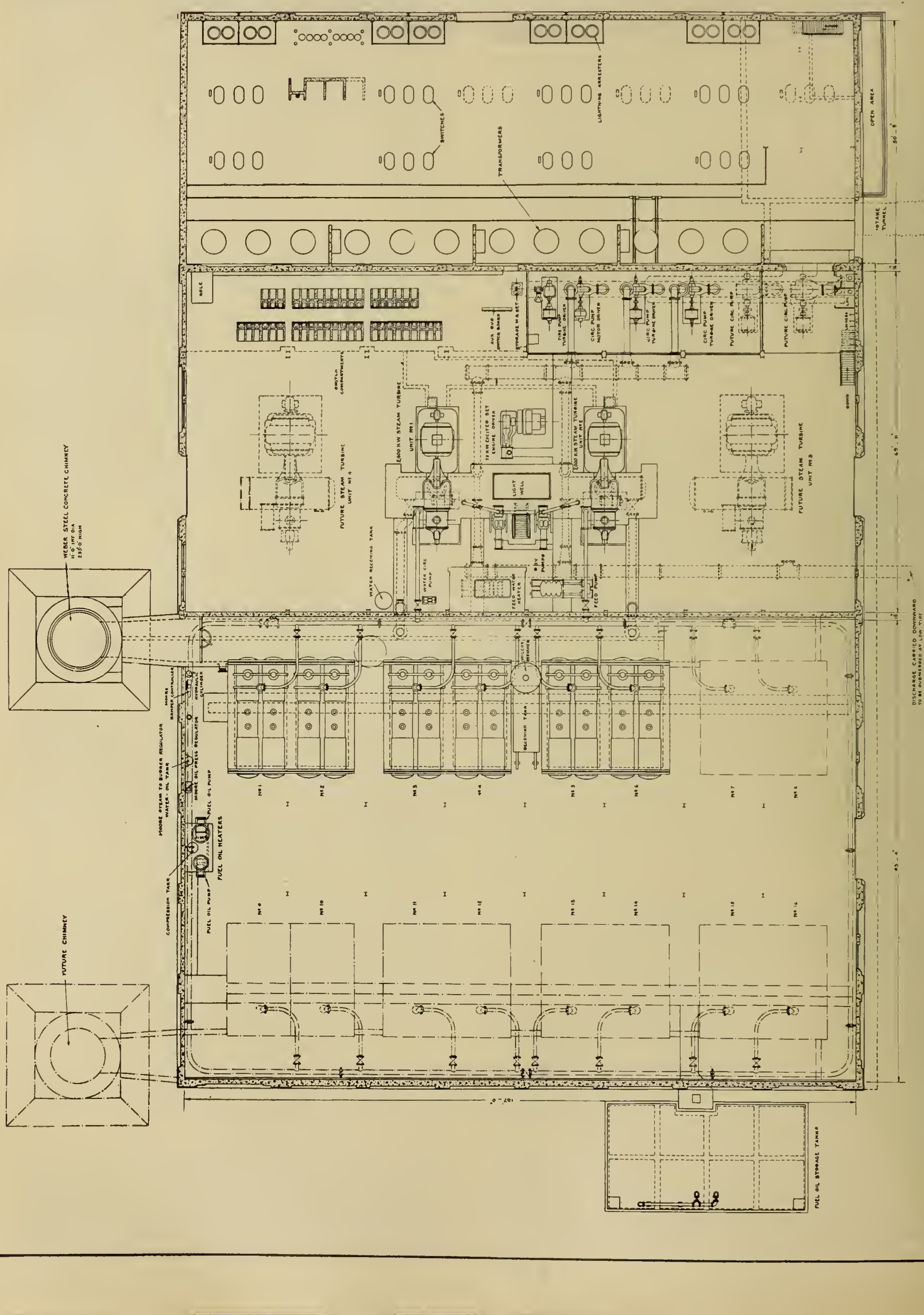
The building is of steel frame construction, with reinforced concrete curtain walls. The structural steel in the boiler room is of sufficient strength to support overhead bunkers suspended between the boilers, should it ever be desired to use coal fuel. The building is divided into three main compartments by walls separating the boiler room and the turbine room, and between the turbine room and the substation. The windows are of ample size.

Boilers

There are six Babcock & Wilcox Patent Safety Water Tube Boilers of forged steel construction, arranged in three batteries of two each. Provision has been made in building for the later installation of ten additional boilers, making a total of sixteen. These boilers were built by Babcock & Wilcox, Limited, of Glasgow, Scotland. Each boiler consists of eighteen sections, each having twelve 4-in. tubes, 18 feet long, over which are mounted two steam and water drums, 48-in. diameter and 24 ft. 3 in. long. The total water heating surface of each boiler is 4,780 square feet. The boilers are designed for a working pressure of 200 lbs. per square inch, and are in accordance with the standard construction of Babcock & Wilcox.

Superheaters

Each boiler is equipped with one Babcock & Wilcox forged steel superheater designed to give from 80 to 100 degrees Fahrenheit superheat at the boiler nozzle when using California fuel oil. If coal is adopted as a fuel, special baffling will be necessary to prevent excessive superheat, as the same amount of surface is not necessary for coal as for oil fuel.



General plan Brentwood Bay Steam plant, Vancouver Island—B.C.E. Ry. Co.

Furnaces

Each boiler is provided with a Peabody patent fuel oil burning furnace, this furnace affording the most efficient boiler performance with crude oil. The furnace is fired from the bridge wall forward, but is controlled at the boiler front. The distribution of flame is over a large area of boiler heating surface, preventing localization of heat and blow-pipe action and minimizing the possibility of burning out tubes. The furnaces are arranged for the use of three burners per boiler.

Exciters

For excitation purposes, a 75 kw., 125 volt, d.c. generator, direct connected to a simple side crank non-condensing, enclosed, self-oiling, automatic engine built by A. L. Ide & Sons, is provided. This exciter is placed between the main units. The engine is designed for the same pressure and superheat as the main units, and it operates very satisfactorily under these conditions of service.

One 75 kw., 125 volt, d.c. generator, direct connected to one 110 h.p., 3-phase, 60 cycle, 2,300 volt induction motor, is also provided for excitation purposes, for use at light loads when the use of the steam-driven unit would cause an excess of auxiliary steam over that required for the heating of the feed water, with its attendant loss of economy.

These generators and motors were supplied by the Canadian General Electric Company.

Condensers

Each turbine exhausts directly through a corrugated copper expansion joint into a Wheeler Admiralty surface condenser of the dry tube type. Each condenser contains 4,000 square feet of cooling surface. The tubes are brass, ¾-in. diameter, No. 18 B.W.G. The dry plates in the condenser drain off the water of condensation as it is formed and allow it to fall to the bottom of the condenser, where it is withdrawn by the hot-well pump. This arrangement prevents the condensation which takes place in the top portion from drowning the lower tubes, thus increasing their rate of conductivity. At the same time the temperature of condensation is increased, the temperature of the air pump suction reduced, and the quantity of circulating water required is diminished. The low temperature of the air pump suction decreases the volume of air to be handled, thus reducing the necessary displacement.

Air Pumps

One Wheeler patent rotative dry vacuum pump of the yoke frame crank and flywheel type is furnished with each condenser. These pumps are of the flashport valve type by which the air compressed in the clearance is automatically transferred to the vacuum side of the piston prior to starting the return stroke. This reduces the effective clearance to a minimum, and increases the volumetric efficiency to a maximum.

Hot-Well Pumps

There is furnished with each condenser and placed directly under it, one cast iron hot-well with a direct connection to a 2½-in. special centrifugal hot-well pump. These pumps are brass fitted, have specially constructed passages to give easy access to the throat of the runner, and each is driven by a 7½ h.p. Kerr steam turbine, operating at 2,400 r.p.m.

Circulating Water Pumps

Three 14-in. Wheeler centrifugal circulating pumps are provided. These are brass fitted throughout. Two of these pumps are direct connected to, and driven by, Kerr steam turbines; the third pump is motor driven. Each pump is of the double suction balanced type and draws its water from a pump pit located directly below, and which will later be described. The water is discharged through individual multiple check valves.

Boiler Feed Pumps

Two Warren horizontal, duplex simple, steam-driven boiler feed pumps mounted on cast iron drip pans, are provided. The pumps operate non-condensing, each pump being of ample capacity for the present plant, the other being in reserve.

Feed Water Heaters

One Cochrane open type feed water heater is provided. This heater receives the hot-well pump discharge and make-up water at the top and distributes it over iron trays from which it falls in a finely divided spray. The auxiliary exhaust is passed through this spray, condensing it and at the same time imparting its heat to the feed water. Ample storage space is provided in which to care for the ordinary variation in water level in the heater reservoir due to fluctuation of load. The supply of auxiliary exhaust steam available can be regulated by the use of either steam or motor-driven circulators, as may be required, so as to obtain a maximum temperature of feed water, and at the same time utilize all the auxiliary exhaust without waste.

Fire Pump

In the pump pit has been installed an Underwriters' fire pump fitted for salt water and connected to a hydrant system throughout the plant. This pump is of the multi-stage centrifugal type and driven by a Kerr steam turbine of suitable power and speed. The pump has a capacity of 750 gallons per minute, against a pressure of 100 lbs.

Main Oil Storage Tanks

Located about 500 feet away from the plant and at an elevation above it, two steel oil tanks each of 5,000 barrels capacity are provided. Each of these tanks is fitted with the necessary connections for filling and emptying, besides heating coils, smothering pipes, drain pipes, etc. The tanks are placed on specially prepared sand foundations and have been surrounded by earth embankments of such diameter and height as to contain one and one-half times the contents of the tank. These embankments are a safety feature provided against the possible failure of the tanks. The tanks are provided with metal covers with access doors and permanent ladders inside and outside. A specially constructed filling pipe has been provided, by means of which the tanks are filled from oil barges or oil tank steamers.

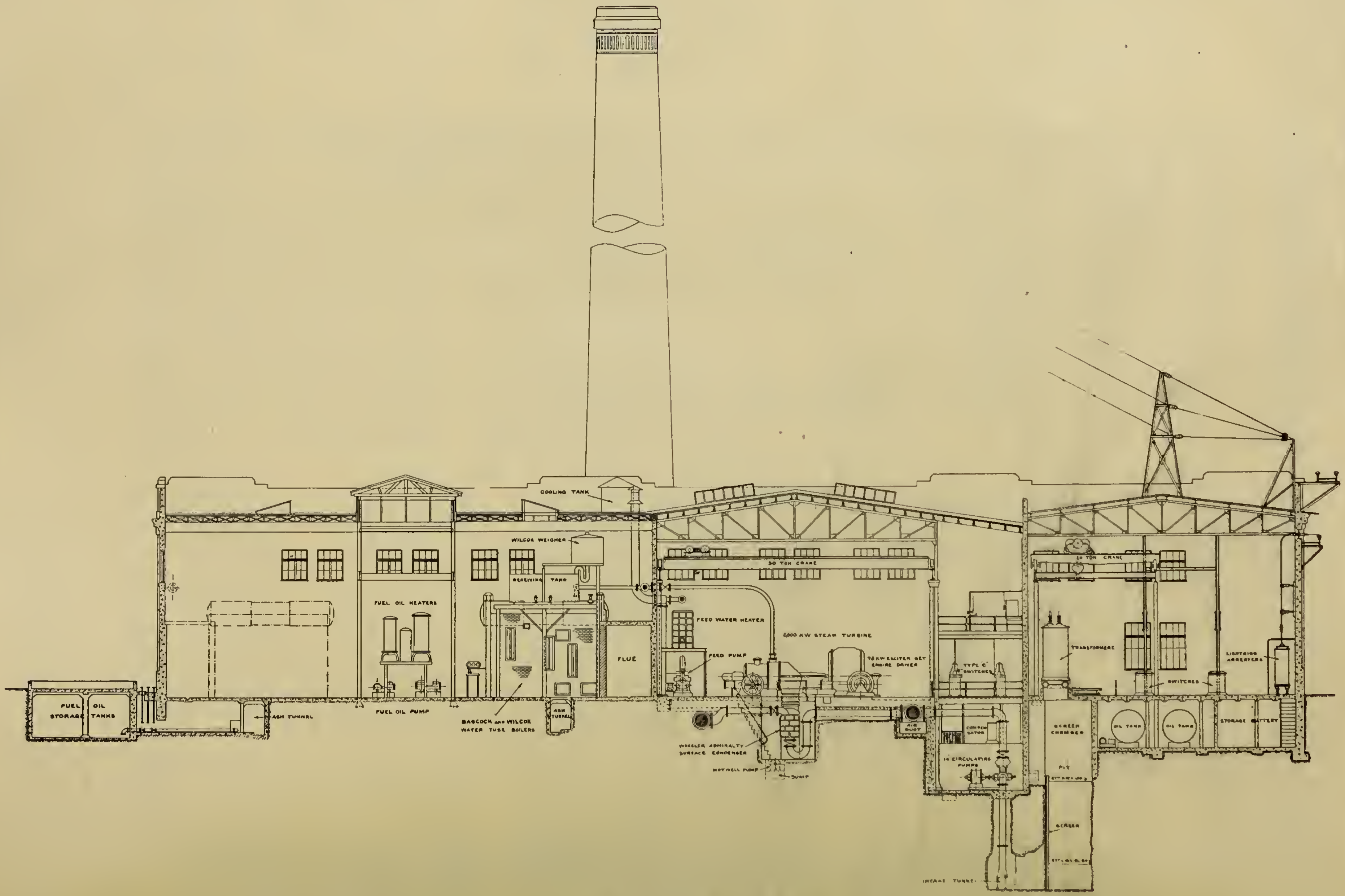
Auxiliary Oil Tanks

The oil pumping equipment by which the burners are fed is not directly connected to the main oil storage tanks. For daily use, two 600 barrel auxiliary oil tanks are provided. These are made of reinforced concrete. The ground is excavated to receive them and the two tanks are built side by side, of a rich concrete mixture and below the level of the boiler room floor. The tanks are fitted with the necessary measuring devices, filling pipes, oil suctions, smothering pipes, heating coils, manholes, etc.

Moore Automatic Fuel Oil Regulating System

The combustion of the fuel oil is automatically controlled by the Moore automatic fuel oil regulating system, invented by Mr. J. R. Atchison and Mr. C. R. Weymouth, of Messrs. C. C. Moore & Company. In this system the fuel oil is pumped to the burners under pressures varying from 10 to 50 pounds per square inch, depending on load conditions, there being a uniform oil pressure throughout all portions of the plant, all burners being wide open, or nearly so. The amount of oil burned with variation of load, is controlled by the pressure of oil at the oil pumps, the intensity of fire increasing and decreasing in all boilers simultaneously.

The oil pressure is automatically controlled by a steam pressure regulator, the variations in oil pressure and intensity



Section through Brentwood Bay Steam Plant, Vancouver Island, B. C.—B.C.E. Ry. Co.

of fire being such as to maintain a uniform steam pressure on the plant.

For atomizing purposes, steam is supplied to the oil burners by a separate low pressure main, the pressure in this main being automatically controlled by variation of the oil pressure in the oil main. A ratio regulator is used, automatic in its action, which maintains such steam pressure in the low pressure steam main as is necessary for atomising the particular amount of oil burned, corresponding to any momentary oil pressure.

The air supply for combustion is controlled by a damper controller, also automatic in its action, which increases the damper opening with an increase in oil pressure and vice versa. The movement of the controlling lever is controlled by the action of the oil pressure on a diaphragm. This movement is opposed by the action of a spring, so that the amount of movement on the main lever is proportional to the oil pressure. This movement is multiplied through a hydraulic cylinder connecting to a rock shaft running over all of the boilers in one panel. Each boiler damper is connected to this shaft, and the connecting levers are set at such angularity, with respect to the connecting rods operating the dampers, that the proper air supply is provided for the various ranges of load, the final adjustment being from actual trial at the plant.

In actual operation and test, it is found that this automatic system of control is safe, reliable, and meets with the approval and hearty endorsement of the firemen. Owing to the fact that the firemen's work is very much simplified by the use of these regulators, they are as much desired by the firemen of the plant as by the management. Were it not for this accord, such automatic contrivance could not be successfully installed and operated.

Piping System

On completion of the ultimate plant, the boiler room main steam piping will form a complete ring with properly located isolating valves. All main steam piping is made up with an improved type of Van Stone joints, and fittings are avoided by the use of welded nozzles. Special anchorages are provided on the columns of the building, and liberal bends are used to take up expansion and contraction. Between anchorages at proper intervals, heavily constructed sliding supports are installed. No cast iron fittings are used on superheated steam lines, and all flanges and bolts are constructed with the idea of making an especially tight system of piping. Following the latest practice, no valve is placed between turbine exhaust and condenser, and should it be desired to operate the turbine non-condensing the steam passes through the top portion of the condenser to the atmospheric exhaust valve. Experience has shown that the conditions under which it might be necessary to operate in this manner are so remote that consideration need not be given to them in comparison with the losses incidental to the air leaks prevalent when using the valve and necessary fittings.

Non-Conducting Covering

All high pressure steam piping is covered with an extra thickness of 85 per cent. carbonate of magnesia sectional covering. Valve bodies and flange covers are also provided throughout. The effect of this heat insulation has been to reduce the attendant pipe radiation, which is particularly desirable on account of the long periods of time during which the plant may be held in reserve with steam pressure maintained.

Chimney

The chimeny is constructed of reinforced concrete with a separate concrete lining and air space extending up one-third of its height. It is 255 feet high and 11 feet inside diameter at the top, and is one of the biggest chimneys in Canada. It is of sufficient capacity to serve eight boilers when operating with coal fuel, and is, therefore, more than able to supply ample draught for the present boiler installation. This chimney is far more pleasing to the sight than the more common type of cylindrical concrete chimney. A brick flue with a concrete cover connects the boilers to the chimney.

For convenience in handling, erecting and repairing machinery, a 30-ton, hand-operated, travelling crane was installed.

Circulating Water System

Cast iron circulating water pipes were used throughout. A large water receiving pit was blasted out of the rock directly below the pumps and this was connected by tunnel with the deep water. Screens of ample area were installed at the mouth of the tunnel. A cast iron discharge pipe, extending below the surface, provides a water sealed return which, due to siphon effect, reduces to a minimum the heads against which the pumps have to work.

Water Supply

As the supply of fresh water near the site of the plant was very limited, a supply was obtained from Durant's Lake, four miles away. The company own the water rights. The level of this lake is about 500 feet above the level of the site of the plant, and at its outlet a timber crib, earth filled dam 12 feet high, with ample spillway capacity is provided. The pipe line for the distance of two miles from the dam, is a steel pipe 6 inches in diameter, and for the remaining two miles it is 4 inches in diameter. This water is delivered at the site of the plant into a 50,000 gallon wooden tank 24 feet in internal diameter, and 16 feet high.

Wharf

For the purpose of reducing the cost of handling oil for use in the plant, a wharf was built at Brentwood Bay for berthing the tank steamer and pumping the oil direct into the oil tanks. This wharf is of "L" shape, and is 250 feet long. It is constructed of ordinary round timber piles, and it was thought inadvisable at the present time to incur any heavy expenditure for creosoted, turpentine, or reinforced concrete piles, as a certain amount of leakage of oil is bound to take place around the wharf, and it is believed that this will have a tendency to prolong its life. The wharf was built by Mr. E. R. Doe, contractor, Victoria, and the largest oil tank steamer can be unloaded at any stage of the tide.

Switching Equipment

The generators and motor generators are connected to the 2,300 volt bus bars through a flexible system of switches, so that any piece of apparatus can, if necessary, be isolated from the rest of the plant. These switches are controlled from a black slate switchboard placed on a gallery in the annex west of the turbine room.

In the h.t. switch room, necessary switches for controling the following h.t. lines are provided: (one) 3-phase, 60,000 volt, incoming line from Jordan River plant; (two) 3-phase, 60,000 volt, outgoing lines to Rock Bay sub-station, Victoria; (one) 3-phase, 60,000 volt, outgoing line to the Tod Inlet Cement Works and the Bamberton Cement Works. Each of these circuits is protected by means of aluminium cell lightning arresters.

The necessary switches are also provided for the following feeders:—two 3-phase, 11,000 volt power feeders; two 600 volt d.c. interurban railway feeders. All of these switches are controlled from the 16-panel black slate switchboard from which the generator switches are operated. For this purpose, a 60-cell, 300 ampere storage battery is used. This battery will also supply current for emergency lights in the building. For motors, pumps, blowers, etc., used in the building, a 2,300 volt service bus is provided. It is protected

(Concluded on page 49)

Flashover of Insulators with Low Frequencies

By Mr. Andrew McNaughton, M. Sc.

When two electric charges are separated by an insulating material, or dielectric, certain conditions of molecular strain are set up. This stress condition in the insulator is conventionally represented by lines of dielectric flux, and the density or number of lines per unit area is taken as a measure of the intensity of the strain.

Most solid and liquid insulators conduct these flux lines considerably better than air, which is the standard against which others are compared. The ratio of the number of lines set up in an insulator to the number which would be set up in a similar air path, with the same applied voltage, is called the specific inductive capacity (s.i.c.). Fig. 1 shows the flux between two parallel plates when air is the insulator, and Fig. 2, when glass is the insulator. The particular sample of glass has a s.i.c. of 5.

While the voltage involved in each case is the same, the actual quantity of electricity corresponds to the number of lines, and is then five times as large per unit area in the case of glass, as in the case of the similar air condenser. That is, in addition to the number of lines of flux per unit area, the s.i.c. has got to be considered in calculating the stress.

$$\text{The stress} = \frac{\text{density of lines}}{\text{s. i. c.}}$$

Fig. 1b, shows the effect of doubling the distance between the electrodes without changing the applied voltage; the number of lines per unit area is reduced to one-half.

Fig. 3 shows the distribution of flux between two spheres, when the path is all air. Fig. 4 shows the flux when a plate of glass is inserted. Note that the actual density in the air film is considerably increased and the distribution slightly altered. That is, though we have inserted a very much stronger insulator in place of part of the air, we have increased the stress on the remainder. This may be shown experimentally as follows—Take two brass spheres 10-in. in diameter, separated about 1-in., apply a voltage and raise it until the air breaks down; this occurs at about 50,000 volts. Now, after taking the voltage off and inserting a plate of glass, again raise the voltage and sparks occur which cross the air film and flash around the glass, the whole combination breaking down at 40,000 volts, which is 20 per cent. less than in the previous case.

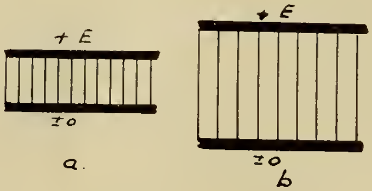


Fig. 1.

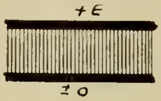


Fig. 2.

Fig. 5 shows the flux between two metal electrodes, on the same side of a sheet of glass. (a) Is an elevation showing the flux in the air and glass; (b) is a traverse section in the air path; (c) is a similar section in the glass just below the surface. The distribution of flux is very similar in the two sections; but the density is very much greater within the glass. Note that very few lines which originate in the air, pass into the glass.

Fig. 6 shows the flux when the electrodes are on opposite sides of the glass plate. In this case most of the flux has got to traverse both an air and a glass path.

Now in making a flash-over test on a sheet of glass with an arrangement of electrodes similar to Fig. 5, we find that it requires 80,000 volts to cause a spark between the electrodes; and further we note that the spark is in the air, not over the glass. In this arrangement the air and the glass paths are in parallel and little alteration in the stress distribution is caused by the insertion of the glass. On the other hand if we use an arrangement of electrodes similar to Fig. 6, sparks begin to spread out over the surface of the glass at a voltage of 30,000; at 50,000 volts flash-over around the surface occurs. In this case the glass and the air paths are in series, and a condition similar to Fig. 4 is established, when the weaker material is called upon to withstand nearly the whole stress.

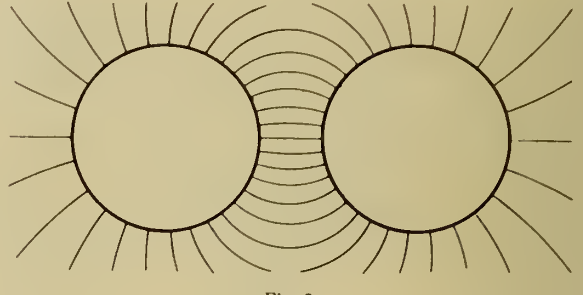


Fig. 3.

It is interesting to compare the flashing distances and voltages in the two following cases:—

	Distance	Voltage	Volts per inch.
Fig. 5	8 inches	80,000	10,000
Fig. 6	25 inches	50,000	2,000

The electric streamers which spread out over the surface have the effect of increasing the size of the metal electrodes.

Fig. 7a shows the stress distribution when one of the electrodes is a needle point. In this case, as the voltage is raised, the surface is flooded with streamers, or corona, and the effective area of the electrode is increased and the local concentration of stress disappears as shown in Fig. 7b.

Fig. 8 shows the effect of placing wax around the needle to prevent the formation of corona. With this arrangement we find that the sheet of glass is punctured by the application of only 40,000 volts, which is 20 per cent. less than that causing flash-over without the wax.

From observation of these simple experiments we see that the fundamental condition which must be fulfilled to give the maximum flashing voltage between two electrodes is to prevent the concentration of the electro-static flux.

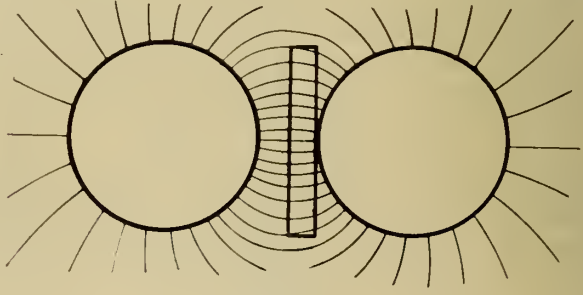


Fig. 4.

Concentration of flux is caused by:—(1) sharp electrodes, (2) paths of high and low s.i.c. in series; so that, in an insulator, the metal parts should be smooth and carefully rounded and the disposition of the porcelain, or glass, should be parallel to, rather than across, the direction of electric stress.

Now, with regard to the measurement of the voltage, the ordinary voltmeters are only suitable for up to about 550 volts. Above that it is necessary to use either potential transformers or electro-static voltmeters, or, better still, some form of spark gap. In actual testing, the spark gaps have the advantage in that they show the presence of any abnormal wave form, while the voltmeters, either electrostatic or electro-magnetic in conjunction with potential transformers, indicate merely the "mean effective value." The breakdown of an insulator of course depends on the "maximum value," rather than on the "mean effective value" of the voltage wave, though for convenience we usually refer insulation tests to the "Mean effective value" of a simple wave having the same maximum.

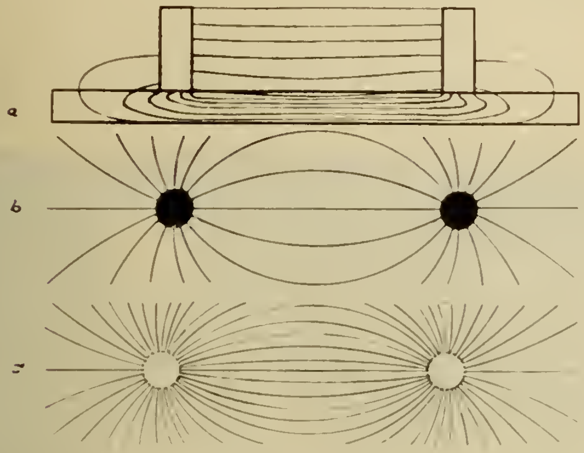


Fig. 5.

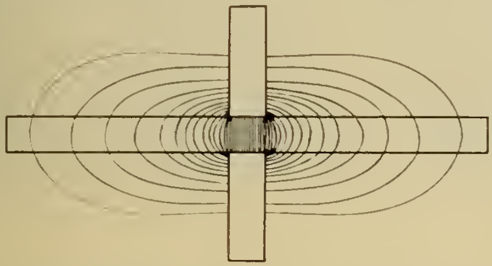


Fig. 6.

Fig. 9 shows the relation of sparking voltage to separation of electrodes, in the case of two needle points. Fig. 10 shows the same relation for spheres 10-in. (25 cms.) in diameter.

The effect on the electric field distribution of neighboring conductors is such as to cause the needle gap to be unreliable, unless it is removed from extraneous objects by a distance equal to at least twice the length of the gap. Thus for high voltages the needle gap occupies a lot of space and is rather inconvenient to use. At voltages below 50,000 it is very convenient and rather more accurate results can be obtained with it than with the sphere gap. As an example, set the sphere gap for about 200 kilovolts and adjust the needle gap to flash over at about the same voltage. In this way you can compare the sparks in the two cases.

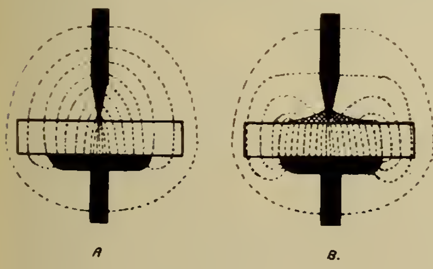


Fig. 7.

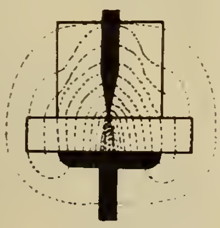


Fig. 8.

To prevent the formation of a power arc, we connect, in series, a water tube resistor of about one ohm per volt. With the spheres, the first sign of distress is the complete arc over. With the needles, a glow is established at a comparatively low voltage; this glow, or corona, gradually builds out as the voltage is increased until arc-over results.

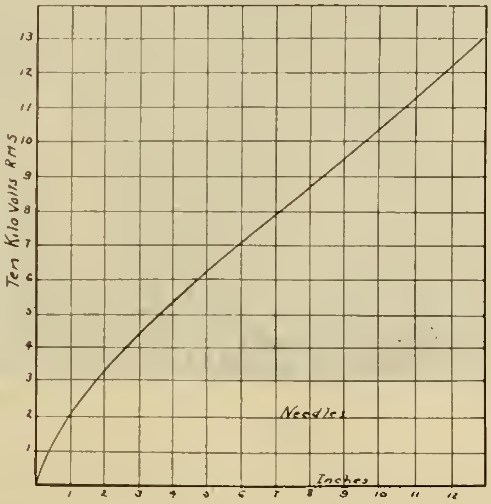


Fig. 9.

In order to obtain accurate results, both the needle points and the sphere distances, d, must be corrected for the density of the air by the following factor:—$d = 3.92b/(273 + t)$, where b = barometer in centimeters of mercury and t = degrees centigrade. Figs. 9 and 10 are drawn for 25 deg. C. and 76 cms. barometer pressure.

Smoke, water vapor, dust, etc., in the air have little effect on the sphere gap but the corona of the needle gap is very sensitive to them and errors of a magnitude of about 15 per cent. are liable to arise from these sources.

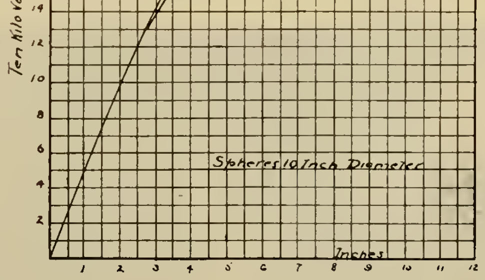


Fig. 10.

The effect of electric stress on the air is so important that an understanding of the mechanism of break down is essential. According to the almost universally accepted Ionic Theory, in addition to the molecules of the gases which go to make it up, the air always contains a number of ions, or infinitely small electrically-charged particles. When the air between two electrodes is subjected to a difference of electric potential, the negatively charged ions are attracted to the positive electrode and the positively charged ions to the negative electrode and the ions get an acceleration proportional to the strength of the field. If now the field is strong enough and the distances between molecules of the air long enough, the ions acquire such a velocity that when they strike a molecule the kinetic energy of the ion, which is then liberated, is sufficient to break up the molecule into other ions. This action is cumulative, and the air between the electrodes becomes filled with positively charged particles which carry electricity from one electrode to the other.

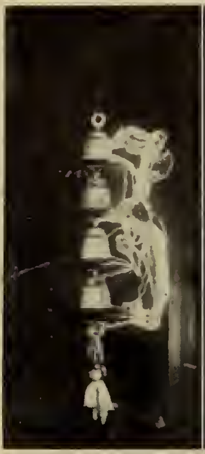


Fig. 12.

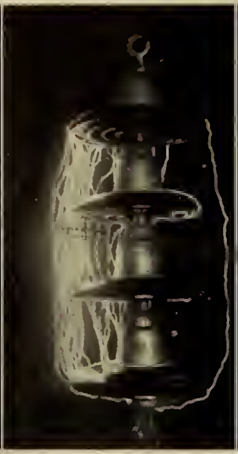


Fig. 13.

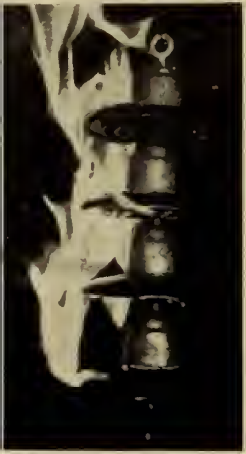


Fig. 14.

As soon as the electro-static field at any point is strong enough to cause ionization by collision, the air at that point begins to glow due to the vibration set up by the collision of the ions and the molecules. This glow is called the electric corona.

In the case of parallel cylinders, where the air between two electrodes is stressed, the corona is first seen at the surface of the wires because, as shown by the curve in that case, the strain in the air is a maximum at the surface of the wire and drops to such a value between the wires that the ions no longer get the necessary acceleration to enable them to reach the velocity at which ionization by collision begins. The fact that ionization by collision, and corona, begin at the same time, and that this time also is that at which the discharge becomes audible, is evident by observation of this experiment.

When the number of ions moving about between the conductors exceeds a certain limiting value, the tendency is for them to come together into a single path which is visible as a spark. If you examine the corona closely you see that the glow is traversed by minute thread-like sparks.

Examination of the formulae used in correcting the values of voltage read from the needle or sphere gap curve shows that at high temperature it takes a relatively low voltage to break down air. Now the spark represents dissipation of energy in the form of heat and so causes a rise in temperature of the surrounding air; hence, when the spark extends clear across from one terminal to the other, the energy may be so great that the air remains broken down and a so-called power arc is developed. Due to the relatively slow rate at which the heat is dissipated from the over-heated air, this arc is able to re-form on the peak of the succeeding wave along more or less the same paths as followed in the previous cycle. Fig. 12 shows an arc of this nature occurring over an insulator. Notice the gradual drift upwards. The frequency in this case was about 250 cycles.

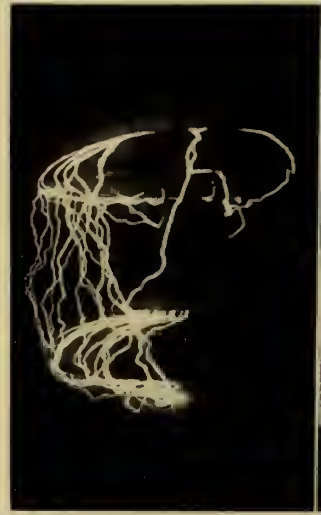


Fig. 17.

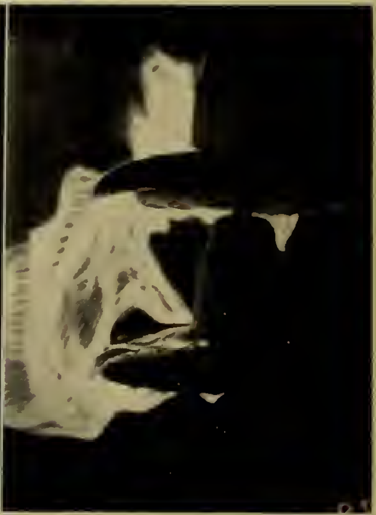


Fig. 18.

Other photographs reproduced herewith show the flash-over of insulators of various size and materials, designed for various line voltages. The Pin Type was tested with both wooden and metallic pin, but using a wooden pin, a materially higher voltage for flash-over and a quite different performance is observed.

The flash-over of a suspension insulator (dry) with suc-

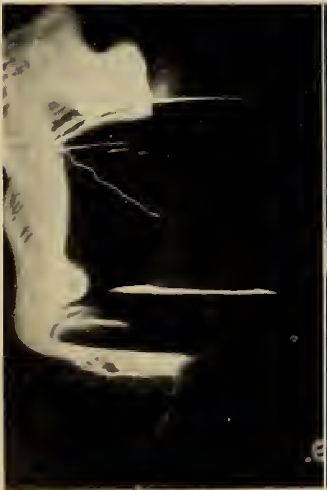


Fig. 15.

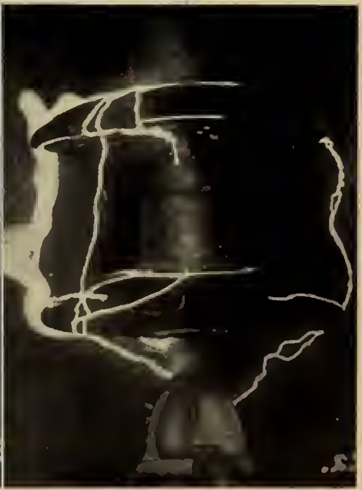


Fig. 16.

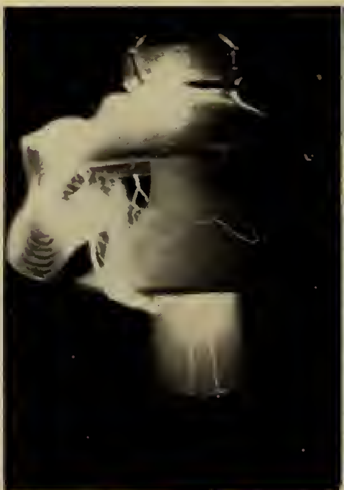


Fig. 19.

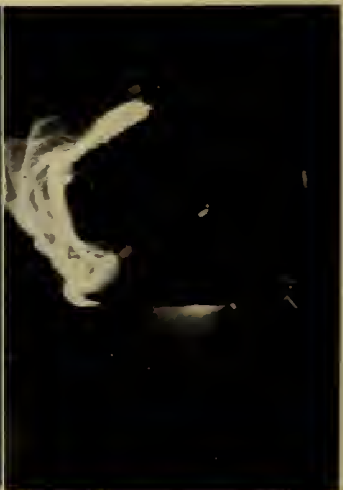


Fig. 20.

cessively increasing number of units in the string gives approximately the following results:

Sections	Voltage	Increase
1	80,000	.....
2	145,000	65,000
3	190,000	45,000
4	220,000	30,000
5	235,000	15,000

The same 5 section unit tested under rain conditions gave a flash-over value of about 200,000 volts.

Fig. 13 shows corona and streamers during test of a four section suspension unit, dry. Fig. 14 shows a power arc with the same unit. Fig. 15 shows corona and streamers with a two section suspension unit, dry. Fig. 16 shows a change of streamers to power arc at a slightly higher voltage. Fig. 17 is a photograph of the corona and streamers on a two section suspension unit under rain test; note that the path is over the surface of the insulator. Fig. 18 represents a change of streamers, with the same unit, to a power arc. Fig. 19 represents a test on a pin type unit with metal pin. Fig. 20 is the same unit under rain test. Fig. 21 shows corona and streamers when using a pin type unit with wooden pin, rain test. Fig. 22 shows a power arc under the same conditions.

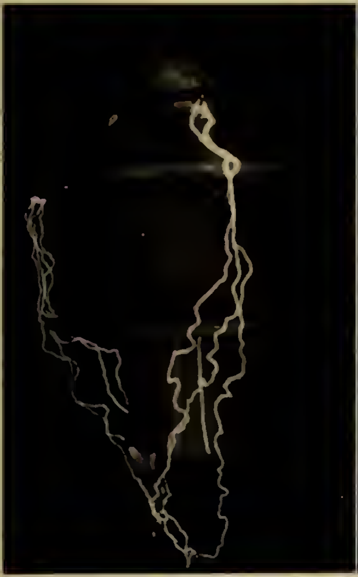


Fig. 21.

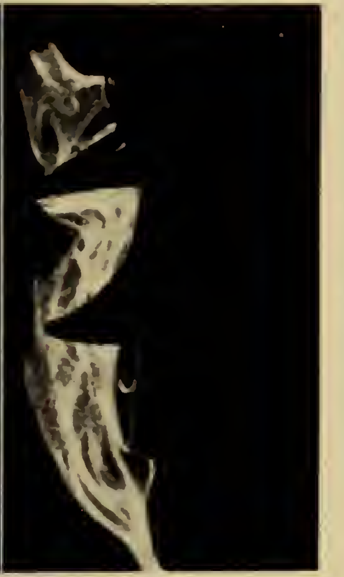


Fig. 22.

(Continued from page 45)

from the main bus by an oil switch of high breaking capacity. The service feeder oil switches are hand operated.

Active construction work was commenced on the 1st of June, 1912, and the first of the two 2,000 kw. turbo-generators was put in service on the 20th of November of that year. The second 2,000 kw. turbo-generator was started up four days later, and since that date the plant has been in operation as an auxiliary without any trouble whatsoever.

As previously stated, the contractors for the work were Messrs. C. C. Moore & Company, of San Francisco, who are to be congratulated on the very successful and expeditious way in which they carried out the work. Mr. C. R. Weymouth is chief engineer of the company, and Mr. J. H. Hopps and Mr. J. R. Atchison represented the contractors on the ground. The work was under the general direction of Mr. G. R. G. Conway, M. Inst. C. E., chief engineer of the British Columbia Electric Railway Company, Limited, assisted by Mr. W. V. Hunt, electrical engineer, and Mr. G. M. Tripp, engineering superintendent, Victoria, both of the British Columbia Electric Railway Company.

High Voltage Systems

The Electrical World has just issued a compilation covering the details of the transmission systems of the world operating at and above 70,000 volts. Perhaps nothing indicates better the rapid advance being made in the electrical industry during the last five years than this list of 54 high tension systems. As an item of interest we give below the names of the companies, the operating voltages, the frequency and their present capacity rating.

Pacific Light & Power Co.	150,000	50	59,500
Au Sable Electric Co.	140,000	60	19,000
Southern Sierras Power Co.	140,000	60	8,750
Utah Power & Light Co.	100,000	60	33,000
Pacific Gas & Electric Co., 125,000 to	110,000	60	25,000
W. Penn. Trac. & Water Power Co.	125,000	60	32,000
Tennessee Power Company	120,000	60	15,000
Connecticut River Transmission Co.	120,000	60	14,400
Inawashiro Hydro-electric Power Co.	115,000	50	42,000
Au Sable Electric Company	110,000	30	9,000
Hydro-electric Power Commission of Ontario	110,000	25	106,800
Lauchhammer, A. G.	110,000	50	15,000
Georgia Railway & Power Co.	110,000	60	50,000
Alabama Power Company	110,000	60	48,000
Mississippi River Power Company	110,000	25	112,500
Lehigh Navigation Electric Co.	110,000	25	30,000
Cedar Rapids Mfg. & Power Co.	110,000	60	90,000
Mexican Northern Power Co.	110,000	60	26,000
Ebro Irrigation & Power Co., Ltd.	110,000	50	50,000
Chile Exploration Company	110,000	50	40,000
Sierra Electric Power Company	110,000	..	.....
Sierra & San Francisco Power Co.	104,000	60	34,000
Great Falls Power Co.	102,000	60	21,000
Yadkin River Power Company	100,000	60	24,000
Colorado Power Company	100,000	60	10,000
Great Western Power Company	100,000	60	50,000
Southern Power Company	100,000	60	75,000
Shawinigan Water & Power Co.	100,000	60	45,000
Los Angeles Aqueduct	100,000	50	22,500
Tata Hydro-electric Company	100,000	50	40,000
Pfalzwerke, A. G.	100,000	50	10,000
Societa Italiana di Elettrochimica	88,000	42	23,280
Appalachian Power Company	88,000	60	20,610
Rio Janeiro Tramway, Light & Power Company	88,000	50	48,800
Sao Paulo Electric Company	88,000	60	30,000
Tasmania Hydro-electric & Metal Co.	88,000	50	.....
Mexican Light & Power Co.	85,000	50	58,500
Toronto Power Company	85,000	25	80,000
Victoria Falls & Transvaal Power Co.	84,000	50	40,667
Northern Power Company	80,000	60	.....
Energia Electrica de Cataluna	80,000	..	.....
Swedish State Railways	80,000	15	26,400
Katsuragawa Denryoku Kabushiki Kaisha	77,000	50	22,400
Southern California Edison Company	75,000	50	20,000
Au Sable Electric Company	72,000	30	3,000
City of Milan	72,000	42	21,000
Societa Generale Elettrica dell'Adamello	72,000	42	45,000
Montana Company	70,000	60	21,500
Hidroelectrica Espanola Molinar	70,000	50	27,000
Pennsylvania Water & Power Co.	70,000	25	71,500
Guadalajara, Mexico	70,000	50	8,000
Societa Elettrica Riviera di Ponente.	70,000	50 & 16 2/3	27,000
Swedish State Railways	70,000	25	17,600
City of Winnipeg	66,000 to 72,000	60	15,000

Electrical Drive of Winding Engines and Rolling Mills

By C. Antony Ablett, A. M. Inst. C. E., and H. M. Lyons, A. M. I. E. E. (Continued)

Power Diagram of Three-Phase Winder

Where the speed of a three-phase induction motor is controlled by placing resistances in the rotor circuit, and the motor is giving a definite turning moment, the same amount of power will be taken from the supply system whatever the speed of the motor may be. The turning moment multiplied by the speed gives the amount of power which the motor uses and the remainder of the power is wasted in the resistances. Thus, the three-phase motor involves great waste of power.

Fig. 4 is a power diagram for a three-phase winder with a cylindrical drum winding at the rate of 270 tons per hour from a shaft 1,600 feet deep, the maximum speed being 40 feet per second. The shaded portions of this diagram represent the power which is wasted in the resistances of the starter in starting and stopping the motor, and in this particular case the useful work done by the winder is 524 horse power minutes per wind. The amount of energy wasted in the starter is 325 horse power minutes per wind. Taking into account the efficiency of the three-phase motor the energy taken by the winder from the supply system is 910 horse power minutes per wind. The average efficiency of the electrical plant, therefore, is only 57.5 per cent.

Comparison of Three-Phase Winder with Ward Leonard and Ilgner Winders

Fig. 4 shows how large the power losses are in starting and stopping a three-phase winder. It also illustrates a case that is much more suitable for a Ward Leonard or Ilgner winder than a three-phase winder, and as the loss in starting and stopping a three-phase winder is very great, it will be seen that it is most advantageous to employ a three-phase winder where the starting and stopping is infrequent, and where there is a long run at full speed, when the three-phase winder is economical, or where there is a considerable interval between winds. These are practically the conditions of a long slope haulage.

Under such conditions a three-phase winder can easily prove more economical in power than the Ilgner or the Ward Leonard winder, because, with the latter, the motor-generator set would have to be kept running continuously and this involves an unceasing though small expenditure of power, so that the energy taken to run the motor generator set can easily be more than the energy wasted in starting and stopping the three-phase winder.

The three-phase winder is advantageous:—

(1) Where the capital cost of the plant is a prime consideration, as the total cost of the three-phase winder is from 20 per cent. to 35 per cent. lower than that of a Ward Leonard winder.

(2) Where the starting and stopping is infrequent and long runs at full speed are required, as is particularly the case with slope haulage.

Lowering Load

There are three methods by which the load can be lowered with a three-phase winder:—

(1) By controlling the speed with the mechanical brakes.

(2) By lowering at such a speed that the motor is run above its synchronous speed and so acts as a generator and returns power to the supply system.

(3) By reversing the connections to the motor so that it is giving its turning moment in the reverse direction to the rotation, and controlling the speed by the use of the ordinary control lever with reverse current.

The third method by which the connections of the motor are reversed, so that it is exerting its torque against the rotation, is extremely wasteful, because the motor takes power from the line in proportion to the turning moment which it is exerting, as well as the power which is given out by the winder, corresponding to the work done by the loads in descending.

As an example of this attention may be called to the lowering diagram, with reverse current, shown in Fig. 5. The amount of energy given up by the lowering of the load is 20,900 horse power seconds. The amount of energy taken by the motor from the supply is 42,900 horse power seconds.

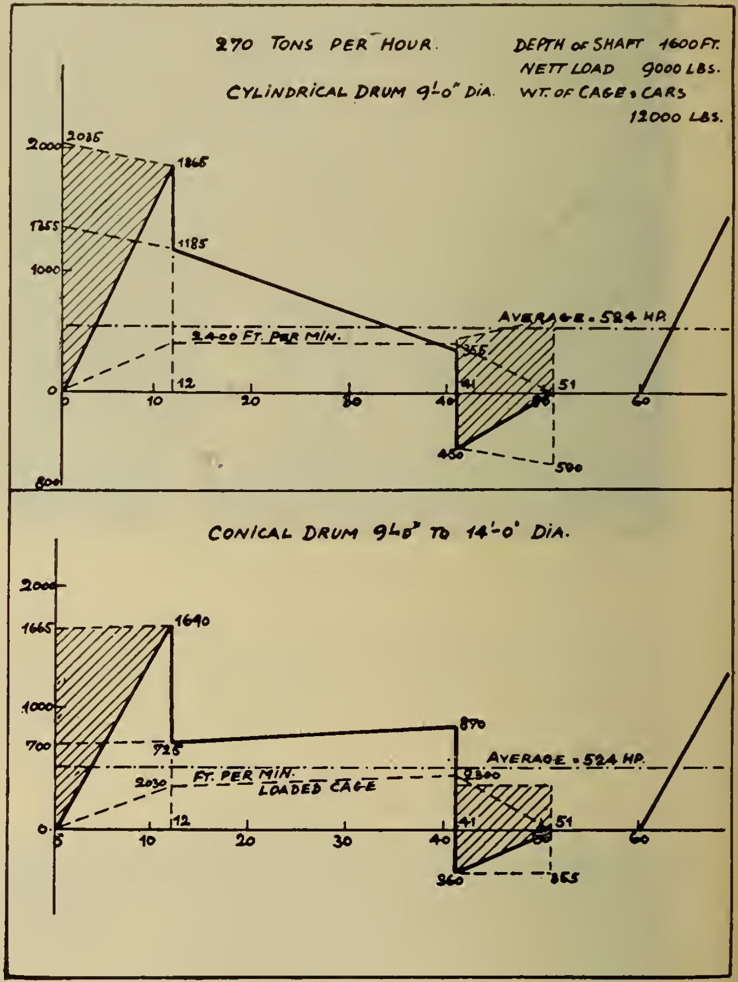


Fig. 4.

Therefore, in order to exert the braking effect on the winder, and to absorb the power given up in lowering the load, which amounts to 20,900 horse power seconds, the starter has to dissipate 63,800 horse power seconds.

It will easily be seen, therefore, that when a load is lowered in this manner, the amount of energy which the starter has to dissipate is very large, and in order to enable lowering to be carried out in this way it would, in many cases, be necessary to employ a much larger starter than is required for controlling the winding engine when hoisting.

This method of lowering is the easiest to control, and, for this reason, although it is very wasteful, it is generally adopted for large three-phase winders.

Emergency Gear

A three-phase wnding engine is provided with a mechanical brake, which is brought into action by means of a weight attached to a lever, but the brake is normally held away from the brake drum by air pressure. If this air pressure fails, then the weight brings the brake on to the brake drum and stops the winder. As the speed of a three-phase winder for a given position of the control lever depends on the load which is being hoisted, it is not possible to provide cams on the depth indicator in order to slow down the cage before it reaches the bank. The proper slowing down of the cage depends on the skill of the driver, but an overhead device is fitted both in the shaft and on the depth indicator, and in case the cage over-runs the bank cuts off the power from the motor and applies the brake by means of the emergency gear.

An emergency lever is provided on the driver's platform by which he can cut off the power and apply the brake, stopping the winder immediately in case of necessity. In case the power supply fails the brake is at once applied through the emergency gear.

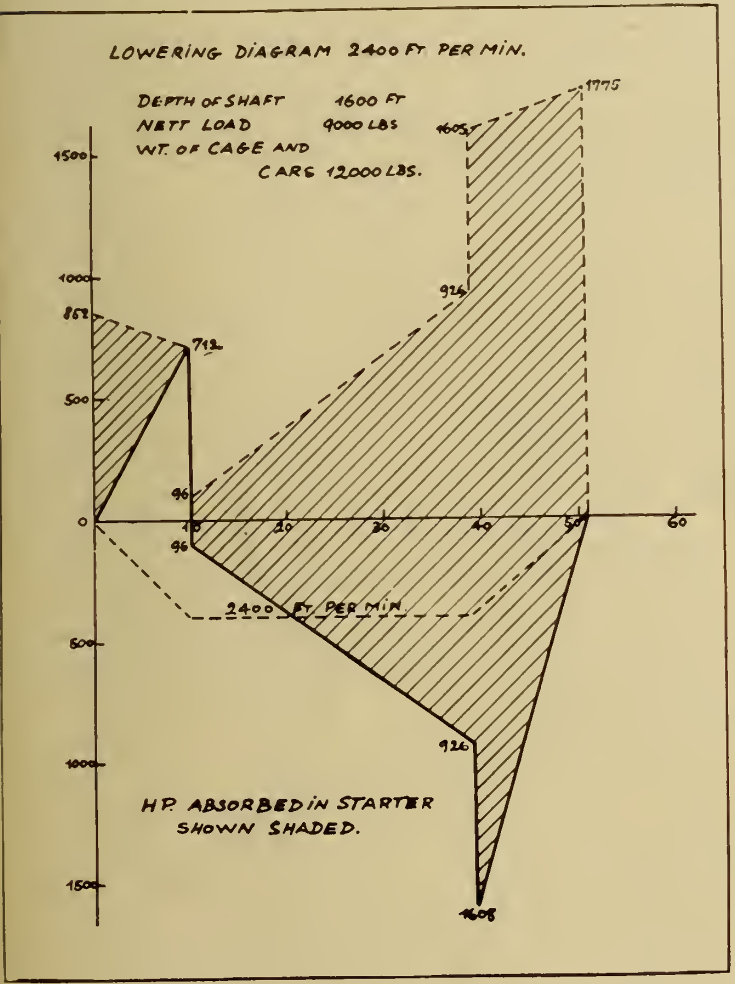


Fig. 5.

Winding Men

With the three-phase winder the speed for winding men cannot be limited automatically, as in the case of a Ward Leonard winder, and the speed depends entirely on the skill of the driver.

General Conclusions Concerning Winding

Generally speaking, the authors are of opinion that the Ward Leonard or Ilgner system of electric winding is the most suitable for vertical shafts, and for all cases where large outputs are required and short and frequent winds are made.

The three-phase winder always has the disadvantage that it cannot be so completely protected against careless handling as either the Ward Leonard or the Ilgner, but it may prove more economical for long slopes where the full speed run is a long one and the periods of acceleration are comparatively infrequent.

Regarding the choice of drums for the winding engine, the authors are of opinion that in many cases where electrical drive is adopted, the cylindrical drum winder will prove the most suitable, but that in cases of deep shafts where the winding speed is high the scroll drum winder may prove better than the cylindrical drum winder, but that the field of application of the conical drum winder to electric winding is very small.

The authors have purposely avoided any comparison between the running costs of a steam and an electrically-driven hoist or rolling mill, because each case should be considered on its own merits and comparisons made for one case will not be valid for another where conditions are different. No general comparison has any practical value. Sometimes the steam engine is the more economical, and sometimes the electrical plant, according to conditions, and in deciding which is the more advantageous there are other factors besides running costs to be considered.

As, however, the authors wish to see a fair comparison made in every case they should draw attention to a very fallacious method sometimes used for establishing the running cost of a steam engine, namely, either indicating the engine or measuring the water rate over an hour or two when the engine is running under the most favorable conditions, and establishing the yearly running costs from these. If tests are carried out over a prolonged period, say several months, a much higher running cost will be obtained, in some cases half as much again, as the standby losses of a steam plant are very considerable, much higher in proportion than those of an electrical plant.

ELECTRIC DRIVING OF NON-REVERSING MILLS

For the driving of a non-reversing mill, that is to say, a two-high, three-high, or double-two-high mill, a flywheel is nearly always used in conjunction with the motor, so that the flywheel assists the motor in providing large powers necessary during the passes, when a bar is going through the rolls, thus enabling a smaller motor to be used than would be required if no flywheel were employed, and reducing the variation in power taken from the supply system.

The motor and flywheel may be either direct coupled to the mill pinions, or the flywheel may be coupled to the mill pinions and a high speed motor provided which drives the flywheel shaft through a gear, rope or belt drive, and in the case of a rope or belt drive, the flywheel itself is often made the large pulley.

There are such great advantages in driving a mill by a direct coupled motor and flywheel, that this method has been adopted in a great many instances, and it may be shown that even for a sheet mill running at so slow a speed as 28 to 30 r.p.m., there are very great advantages in employing a direct coupled motor and flywheel in spite of the high capital cost, which has led to this direct coupled drive being adopted for a number of sheet and tin-plate mills.

Where a high-speed motor is installed, the flywheel should always be coupled to the mill pinions, for it is a bad practice to install a high speed flywheel coupled to the shaft of the high speed motor, because the stresses due to the power given up by the flywheel are undetermined, as these depend on the rate of deceleration of the flywheel, and if these stresses had to be transmitted through gears, ropes or belts, they either have to be designed with a very large margin of safety, or else they are liable to be unduly stressed and suffer damage. It is always a good principle to couple the flywheel to the mill pinions in as direct a manner as is possible.

To enable the flywheel to assist the motor by giving up some of its stored kinetic energy so as to provide part of the power required during the passes, provision must be made so that the motor and flywheel fall in speed as the power required increases, that is to say, the motor must be artificially made to decrease in speed to a considerably greater extent than it normally would with an increase in power. This artificial increase of the fall of speed can be obtained by either of two methods:—

(1) By arranging that the speed shall steadily decrease as the power given by the motor increases. Where the mill motor is a direct current motor, this is done by providing the motor with a compound winding, which causes the necessary fall in speed without loss in power.

Where a three-phase mill motor is installed, resistances must be inserted in the rotor circuit, which cause a definite loss in power as the speed decreases.

(2) By arranging that the speed shall commence to decrease after the motor has reached a predetermined load. This is done by introducing some electro-mechanically operated device, such as a relay, which diminishes the resistance in the shunt field of a direct current mill motor when a predetermined load is reached, or a relay, which in the case of a three-phase motor, increases the resistance in the rotor circuit.

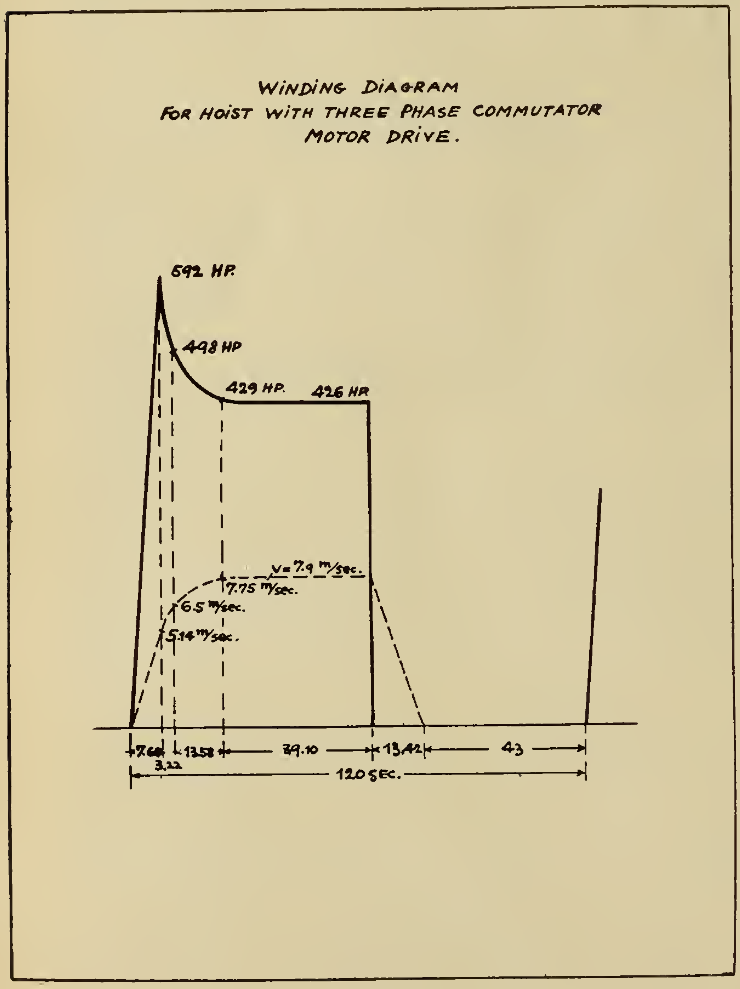


Fig. 6.

This second method of artificially increasing the fall in speed or slip is often spoken of as automatic slip regulation, but the term "automatic" is a misleading one, because both methods are automatic, and it would be more correct to call the first method "permanent slip regulation," and the second "intermittent slip regulation."

Speed Variation

In Europe the ordinary three-high merchant mill with roll diameters ranging from 10 in. to 18 in. is required to roll as many different sections as possible to meet the conditions of trade, and the smaller mills have to roll sections from either steel billets, scrap piles or puddled iron bars.

To meet these conditions such mills have to be able to run at a considerable number of different speeds.

It is always desirable to run at as high a speed as possible to get large outputs, but it is not possible to roll large steel billets at as high a speed as small billets, for it would be a physical impossibility for the men to catch a large and heavy steel billet thrown from the first pass of the roughing mill at a high speed.

Iron must be rolled at a much slower speed than steel, for if iron bars are rolled at a high speed they would be torn up and spoiled.

Guide rounds or squares can be rolled at a much higher speed than hand rounds or squares, for where guides can be used they hold the bar in position, but in rolling hand rounds the roller has to hold the bar in position with his tongs, and the speed of rolling must not be faster than he can walk or else he cannot follow up the bar.

The conditions for driving such a mill are very well fulfilled by the direct current compound wound compensated motor, because it can be set to run at any basis speed suitable to the section being rolled by regulating the shunt field, while the compound winding acts as a permanent slip regulator, and gives the necessary fall in speed, without wasting power, to enable the flywheel to give up part of its stored energy to assist the mill motor when required.

When the billet is out of the rolls the mill motor will not run above the basis speed to which it has been set, so that there is no difficulty in entering the next billet.

The three-phase induction motor is not at all well suited for driving such merchant mills, because its speed can only be reduced to that suited to the section being rolled by inserting resistances in the rotor circuit, and attention has already been called in the three-phase winding engine section of this paper to the great variation of speed which takes place with change of load, when the speed of such a motor is reduced in this way.

Suppose that the mill quoted under example 1 were driven by a three-phase induction motor having a synchronous speed of 250 r.p.m., and, in order to roll large billets, such resistance was inserted in the rotor circuit to bring down the speed to 120 r.p.m. at a definite load. As soon as the bar was out of the rolls the motor would speed up, and, if the interval before the bar was re-entered was at all long, the speed of the motor would be nearly up to 250 r.p.m., so that it would be very difficult to re-enter the bar, and to re-enter a fresh billet at this speed would be almost impossible, as the rolls running at such a high speed would not grip the large billet. A mill driven in this way would be practically unworkable.

Suppose the motor were a 500 h.p. motor, then, if the speed were reduced to this extent, about 250 horse power would be wasted in the resistance if the motor was giving the turning moment corresponding to its full load. Such a three-phase drive is also extremely wasteful.

The most successful method of utilizing three-phase current to drive merchant mills working under such conditions, which has yet been devised, consists in installing a three-phase motor direct coupled to a smaller compound wound direct current motor for driving the mill and providing a rotary converter having its sliprings connected to the sliprings of the rotor of the three-phase motor and its commutator connected to the commutator of the direct current motor. When it is desired to run this mill motor combination at speeds below synchronous speed, the power which would otherwise be lost in resistance in the rotor circuit for the three-phase motor is converted from three-phase to direct by the rotary converter and beneficially used in the direct current motor to assist the three-phase motor in driving the mill.

This system is therefore economical and the three machines together behave something like a direct current compound wound motor. That is to say, the mill motor set can be adjusted to run at any basis speed suitable to the section being rolled by regulating the shunt field of the direct current motor, while the compound winding of this direct current motor acts as a permanent slip regulator, giving the necessary fall in speed to allow the flywheel to take effect, without entailing any loss in power.

It will also be seen that, when the bar is out of the rolls, this set will not speed up to the synchronous speed, but will be limited by the basis speed to which the direct current motor has been set. Such variable three-phase sets have been installed for driving 8 or 9 different merchant mills, with very good results, the largest being a 1,300 h.p. set, and it is quite easy to obtain a 3 to 1 speed regulation, economically, in this way, and to get any speed at all, within these limits, while the turning moment which the set can give, increases as the speed is reduced.

CONCLUSIONS CONCERNING ROLLING MILLS

The authors are of opinion that direct current is much better adapted for driving mills and machinery in a steel works than three-phase current.

Where large reversing rolling mills are driven electrically, and the motor driving the motor generator set is supplied from a direct current system, it is found that the power supplied to the rolling mill plant can be maintained at a much steadier value than if it is supplied from a three-phase system, and with the direct current motor about a ten per cent. saving in power can be effected, as there is no loss of power in slip resistances.

With a direct current system the flywheel of the motor generator set can be utilized to a great extent for neutralizing sudden peaks of short duration in the power demand on other parts of the system, for, during such a peak, the motor generator set would not only cease to take power from the supply, but the motor can be actually reversed, and give its full output as a generator returning the energy of the flywheel as electrical energy to the supply system.

With a three-phase system, peaks in other parts of the system cannot be neutralized to anything like the same extent, for the motor can only be made to cease to take power from the supply system and cannot act as a generator returning power to the supply system.

It has been shown that the direct current compound wound motor is very well adapted to fulfil the conditions for driving three-high merchant and bar mills and that considerable complication and difficulties are involved in adapting the three-phase motor for this purpose.

Direct current motors are also particularly well adapted for driving slow speed sheet and tinplate mills, as it is very easy to provide a slow speed direct coupled motor and gain the advantage and economy of this drive, and, as there is no loss of power in slip resistances, the direct current motor will prove from twelve to fifteen per cent. more economical than the three-phase motor on this current alone.

The advantages of direct current table and live roll motors are so fully recognized that they need not be recapitulated here, but it is interesting to note that in perhaps the largest steel works on the American Continent, where the main power supply is three-phase, all the table motors are direct current and a large and costly installation of converting machinery has been provided to convert the three-phase current to direct current to supply these table motors.

It may be argued that the cost of cables with a 500 volt direct current system is much higher than for a high voltage three-phase system, but it must be remembered that a well laid out steel works is comparatively compact and the distances are relatively short, so that the cost of cables is not a very serious item, and that the additional capital cost of a three-phase generating plant to produce power, which is wasted in the slip resistance, etc., will pay for a good deal of extra cable.

In steel works where there are blast furnaces and coke ovens, the modern tendency is to instal large gas engines using blast furnace or coke oven gas, both for driving the blast furnace blowers and for generating electrical power, and experience shows that a direct current gas engine power house is cheaper in capital cost and easier to operate than a three-phase power house.

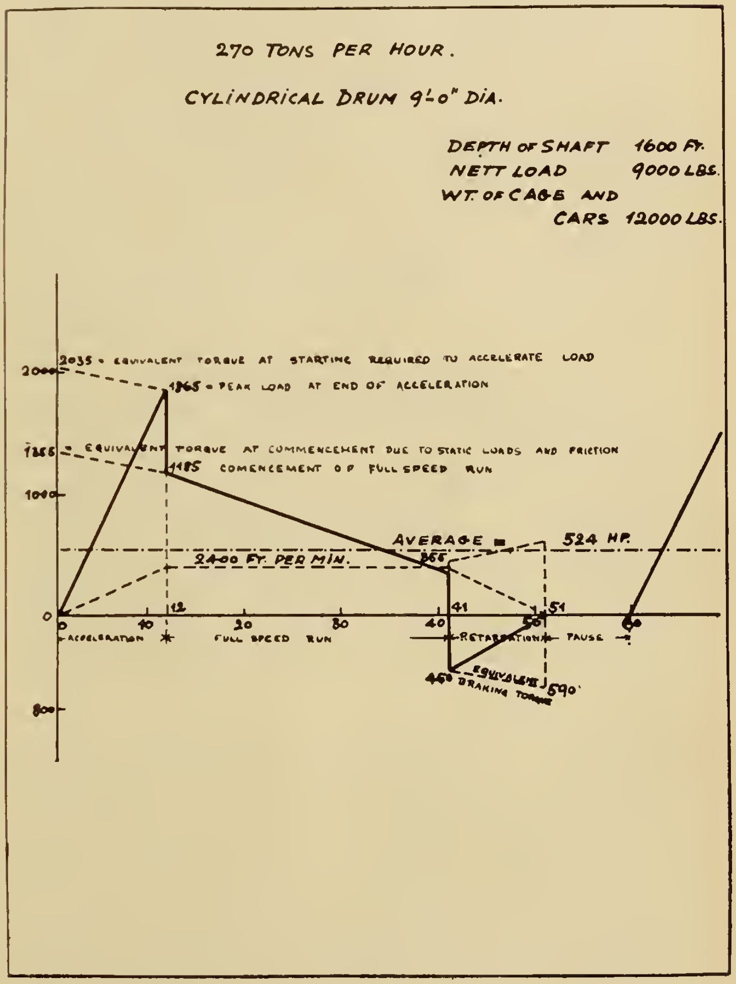


Fig. 7.

Gas engine driven three-phase alternators present the most difficult problem in parallel running, and while sufficient experience has been gained in the past ten years to enable these difficulties to be overcome by proper design, the provision of very heavy flywheels is always necessary, and these largely increase the capital cost of the three-phase generators, which are intrinsically more expensive than direct current generators. The higher the periodicity the heavier the flywheels for the three-phase generators become. The 500 volt direct current system has found very wide application in the steel works on the continent of Europe.

Electric Railways

The Development of Electric Traction

By John R. Hewett[*]

The steam railroad is just about a century old and the electric railway about a quarter as old, and when we think of the astounding developments that have taken place in this comparatively short space of time, we can hardly refrain from asking ourselves why this development has come about. The answer to this question would seem to be that the civilization of the world is absolutely dependent upon rapid communication between man and man—the communication of thoughts and of material matter. The invention of the steam engine and locomotive pointed the way and then, with the introduction of the electric telegraph and the submarine cable, the different peoples of the world became so much more closely connected in thought that the general extension of a more rapid means of physical communication seemed imperative. The stage coach on land and the sailing ships on the seas had to be replaced by quicker methods of communication. It was about the beginning of the nineteenth century that people began to recognize that the country which developed the best means of rapid communication with other countries would be the leader in the commerce of the world—those that had most ships would control the seas and the markets of the world; and, similarly, that it was only those countries that developed an efficient system of land transportation that could develop their natural resources and consequently become manufacturing countries.

The recognition of these great economic truths came about just at a time when the whole world had been well nigh torn asunder and rent by a series of wasteful and disastrous wars. In looking back at the history of this period, the development seems miraculous. All sections of the civilized world would seem to have taken on a new form of life, and commerce became to be recognized as a better trade than war. The development of better means of communication aided the rapid spread of civilization and the spread of civilization stimulated industrial developments of all kinds. Thus was started an action and a reaction which has been continued up to the present time, with the result that today a man living in New York knows more about the capitals of China and Japan than his grandfather knew about many towns scarcely a hundred miles from his own door, and that each of us individually to-day are virutally in connection with the whole rest of the world. It is easier to make a trip around the entire globe to-day, in comfort and in luxury, than it was to travel from one end of New York State to the other, at the cost of hardships and dangers, a hundred years ago.

These developments have absolutely changed our modes of living and during the transition stage one thing of vital importance has happened, viz., we have let these means of communication become our masters as well as our servants. When we stop to consider the enormous populations congested into our large cities, and the distances from which their daily food supplies have to be transported, it is apparent that our means of communication are the masters of the situation. Should they for any reason fail to fulfill their functions in the community for even a brief time, it would spell death by starvation to hundreds and thousands of human beings.

So in this brief period of one century we have built up a set of conditions that has so complicated our modes of living and increased our dependence on the labors of others, living at a great distance from us, that now our transportation facilities have become just as much one of the necessities of life as are food and clothing. The character of our transportation systems has thus become a matter of national importance.

It was long after this civilizing movement had set in and become well established that the electric railway made its appearance. In fact, it is just about twenty-five years ago that Sprague, Van Depoele, Daft and Bentley-Knight, amongst other energetic pioneers in the industry in this country, began to show the possibilities of this new mode of traction. In this short space of time electric traction has not only become well established, but has grown to be one of the most important industries in the country. In the last twenty-five years electric traction has, practically speaking, superseded all modes of transportation for city, suburban and interurban service, including elevated railways and subways. A whole paper could be written with profit to show the advances that have been brought about in our social status by the electric railway. There are few who realize how much the public and especially those interested in real estate have benefited by the enterprise of those who have been responsible for the building of our electric railway systems, but we have not time to go into this phase of the subject here.

The field is broad

It seems to-day that the field for electric traction is as broad as the traction field—that is to say, that it has been developed to a stage where there are no longer any technical limitations to its adoption on every railroad in the country. The traffic could be handled electrically and the considerations which govern the choice between steam and electric traction are financial and economic, not technical. Within the last decade, we have seen many notable examples of the electrification of steam railroads, and judging by the general interest that has been awakened in railroad circles and the recognition of the splendid service being performed by those electric installations already made and the economies secured by their adoption, we shall see many more examples of steam railroads adopting electric traction during the next decade.

All modes of traction depend primarily upon energy, and whether steam or electric traction ultimately becomes universal depends upon the relative economic values of the form of energy used. It should be noted here that of all the forms of energy available, only two are generally considered for traction purposes, viz., the chemical energy stored in coal and electric energy. Dr. Steinmetz in a paper before the Franklin Institute has recently pointed out the reason for this, viz., because they are the only two forms of energy that can be economically transported or transmitted over long distances. The two following paragraphs are taken from Dr. Steinmetz's recent paper:

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[*] General Electric Review.

"Electrical energy can be transported or, as we usually call it, transmitted—economically over practically any distance. Mechanical energy can be transmitted over a limited distance only, by belt or rope drive, by compressed air, etc.; heat energy may be carried from a central steam heating plant for some hundred feet with moderate efficiency, but there are only two forms of energy which can be transmitted over practically any distance, that is, which in the distance of transmission are limited only by the economical consideration of a source of energy nearer at hand—electrical energy, and the chemical energy of fuel. These two forms of energy thus are the only competitors whenever energy is required at a place distant from any of Nature's stores of energy. Thus, when in the study of a problem of electric power transmission we consider whether it is more economical to transmit power electrically from the water power or the coal mine, or generate the power by a steam plant at the place of demand, both really are transmission problems, and the question is whether it is more economical to carry energy electrically over the transmission line, or to carry it chemically, as coal by the railroad train or boat, from the source of energy supply to the place of energy demand, where the energy is converted into the form required, as into mechanical energy by the electric motor or by steam boiler and engine or turbine.

"Electrical energy and chemical energy both share the simplicity and economy of transmission or transportation, but electric energy is vastly superior in the ease, simplicity, and efficiency of conversion into any other form of energy, while the conversion of the chemical energy of fuel into other forms of energy is difficult, requiring complicated plants and skilled attendants, and is so limited in efficiency as to make the chemical energy of fuel unavailable for all but very restricted uses: heating and the big, high-power steam plant. To appreciate the complexity of the conversion of the chemical energy of fuel, compared with the simplicity of electrical energy conversion, imagine the domestic fan motor with coal as source of energy; a small steam engine, with boiler and furnace, attached to the fan; to start the fan, we have to make a coal fire and raise steam to drive the engine. This illustrates how utterly unavailable the chemical energy of fuel is for general energy distribution. Generally energy distribution, therefore, may justly be said to date from the introduction of electric power."

From the foregoing it will be seen that electrical energy and the chemical energy stored in coal are the only two available sources of energy for traction purposes, and that in the case of coal we have to carry our fuel and generating apparatus adding enormously to the weight of the moving element and consequently to the cost of transportation, while in the case of electrical energy, there is no fuel or generating apparatus to be transported. This gives electric transportation a tremendous advantage, but at the same time it must be remembered that in the case of electric traction we have to provide the means for supplying the energy, which means the construction of a trolley system or third rail for the whole length of the line.

The general extension of hydro-electric developments which is fast covering the country with a network of high tension transmission lines is making a source of cheap energy available in many localities. This development will prove quite an asset to many roads who would rather buy than manufacture their own power.

In the case of electric traction, the range of energy supply is very flexible—we have the whole resources of the power house available—while with steam traction,, if we want excessive power for only a short distance we have to transport sufficient generating apparatus and fuel all the time we are working at light loads.

So the question of the electrification of steam railroads resolves itself to a question of whether it is cheaper to build a system for the distribution of energy for the whole length of the line than to carry the fuel and generating apparatus along with our freight and passenger trains.

This is absolutely a question of economies, and will be settled as such in each individual case after a careful analysis has been made of the individual requirements.

If the traffic was sufficiently dense, it would always pay to electrify a railroad, because the economies to be secured by electric operation would more than offset the interest to be paid on the initial expenditure, but where the traffic is scarce and the length of the line is long, that is to say, where the initial cost of electrification and the cost of operating and maintaining permanently an extensive system of energy distribution would be great, in comparison with the cost of hauling the fuel and generating apparatus along with the train, then steam traction is still the most economical.

We have many examples of steam railroads with dense traffic that have made or are contemplating the change from steam to electric traction to secure these economies, and also many special cases where electrification has come into being to secure some special economies or overcome some special conditions, such as the abatement of smoke in terminal stations, etc.

A difficult engineering problem

The analysis of operating conditions to determine whether it would be economical to electrify or to continue steam operation is becoming an important branch of the engineering profession. There are to-day many instances where electrification would pay, but where difficulty would be found in financing the undertaking. When some of the roads that are contemplating electrification have done so and have gained the experience from actual practice, it is likely that other roads will follow their example and that the electrification of our steam railroads will become one of the large electrical industries of the country.

When an analysis of the conditions in any particular instance has shown that electrification would be economical, we still have to determine which of the available systems of electrification is best suited to the requirements. This is purely a question of economics, and here again is the necessity for a careful analysis to determine the most economical way of distributing the expenditures to be made in the initial construction, the operation and the maintenance of the system.

For example, when the traffic is very dense, and where cars or trains of moderate size have to be run at very frequent intervals and the total energy used at any one instant is not very greatly in excess of the average load, then standard 600 volt apparatus has no equal. There is no objection to the heavy outlay in sub-station apparatus and feeder copper when such apparatus will be in operation at an efficient load factor for a good percentage of the twenty-four hours.

It is when the load is such that the cost of copper and of the machinery installed in the power house and sub-stations is excessive, and the percentage of time that they will be working at anything like an efficient load factor is small, that we look about for ways and means of reducing the amount of machinery necessary and of increasing the time that it will be in actual use. As a matter of fact, these conditions are just what exist on most systems where electrification is contemplated, and it is to meet such conditions and make electrification an economic possibility that the high voltage systems, viz., the three-phase system, the single-phase alternating current system and the 1200 and 2400 volt direct current systems have been evolved; in other words, higher voltage is an economic necessity to avoid excessive expenditure in copper and in machinery which would only be working at part or no load for a great percentage of the working day.

The three-phase system has found but little favor up to the present in this country, while it has been very extensively adopted in Europe; but there is one case, viz., the electrification of the Cascade Division of the Great Northern Railway, where such a system has been in successful operation for some years in this country. It would seem in the light of our present knowledge that such a system, at least for conditions as they exist in this country, is likely to be confined to mountain grade work where the advantages of regeneration can be secured. On the other hand, as the high potential direct current system has been developed with these same features, there seems little to warrant the additional complication of the three-phase trolley.

During the last decade the relative merits of single-phase alternating current and high potential direct current systems have been freely discussed, and many examples of each system have been installed and have been operated for a sufficiently long period to enable a logical opinion to be formed as to their relative merits. It would be impossible to enter into a detailed discussion of this phase of the subject in a paper of this length, but judging from the results of operation, as published, and the number of single-phase interurban roads that have been changed from single-phase alternating current to direct current, and from the number of direct current roads now in successful operation, and the fact that no roads adopting higher direct current potential have changed, and the present ratio of alternating and direct current work now under construction and contemplated, it would seem safe to infer that at present, at least, the higher potential direct current road has a decided advantage over all other systems for heavy traction work.

What the future has in store no one can say. The alternating current system or some modification of it may be developed along lines that will enable advantage to be taken of its good features, and its inherent limitations to be overcome. And again, new modes of power transformation may come into use such as rectifying alternating current to direct when the advantages of the alternating current secondary distribution could be combined with the excellent characteristics of the direct current railway motor. But if we start speculating on the future, there is no limit to the range of our imagination.

No standard as yet

There has recently been said, both in the technical press and elsewhere, a great deal about what people are pleased to style "The Battle of the Systems." Some people have taken the attitude that electric railway developments have been hindered because all manufacturers of electrical apparatus are not agreed upon the best system for heavy traction purposes. Such people are prone to infer that such a condition of things is hindering development, and that the manufacturers are responsible for this condition. As a matter of fact, such differences of engineering judgment, when there are several different methods of attacking a problem, must, in the long run, be beneficial to the railroads rather than harmful, as without such differences of judgment, the possibilities of the art can at best be but imperfectly developed. When any art has been developed to a reasonable state of perfection and the fundamentals have been well considered and thoroughly tried, and after the process of eliminating the less suitable factors and perfecting those which have shown themselves capable of meeting the necessary demands, under actual service conditions, has been carried to the point where our knowledge, based on experience, enables us to retain the good and reject the bad, then and not until then, is the time to talk of standardization. An attempt at standardization when an art is in a more or less embryo state is likely to work a permanent harm inasmuch as it limits our knowledge of the broader engineering possibilities that might be brought to bear upon the subject. This question is of such importance to-day that it is worthy of consideration from both sides.

This so-called "battle of the systems" to-day is, as we all know, applied to heavy traction between single-phase and high voltage direct current. Briefly, there are two courses open: to attempt to standardize one, or to try both. First, let us imagine that we are living under such conditions that an imperial edict has been issued that single-phase is par excellence and that henceforth every railroad in the country that wishes to be electrified must use this system. This is not very far from what has happened in Germany. The first fruits of such a condition might possibly be that a great amount of talent would be focussed upon one subject and that developments along certain limited lines might be stimulated. Also, the customers or railroads would be relieved of any worry concerning the selection of the correct system. There would be no choice in the matter; they must take what was presented or leave it. Under such conditions, the field of research and development would be limited to such an extent that any inherent limitations in this one system of electrification would literally form a stone wall across the paths of progress. If there are inherent limitations in any system and we insist on its adoption, we are hindering rather than helping the permanent sound progress of the art. On the other hand, when there are two or more systems that are recognized as competitors, and there are, as it were, opposing camps, one side championing one system and the other side championing the second system, we are building on broader foundations. As a matter of fact, the battle of the systems is merely a bogy—the selection of the best electrical apparatus to meet the service conditions in any particular case is the settlement of engineering details—not the adoption or rejection of a system.

There are some engineering firms that have thoroughly tried out all the apparatus which has been developed up to the present time, and their judgment in these matters is tempered by experience and costly tests, and the railroad companies are getting the benefit of this experience.

The development of the higher potential direct current railroad is of peculiar interest, as the apparatus used has gone through such a logical sequence of evolution. It is just about a decade ago that we began to recognize that 500 or 550 volts was no longer the standard potential for railway work. The voltage had gradually been raised from these figures to 600 volts until there were more roads operating on 600 volts than at any other potential. When this condition was recognized, 600 volts was talked of as the standard The evolution from 500 to 600 volts was largely brought about by a gradual increase of the traffic on existing systems, the raising of the voltage being the simplest and cheapest method of meeting the severe demands. There have been isolated cases of roads operated at 700, 750 and 800 volts, and the step from these potentials to 1200 volts was a comparatively small one. It should be specially noted that the increase from 500 to 600 volts made no difference whatsoever in the design, construction and operation of the equipments. When the jump to 1200 volts was taken, it was made for purely economic reasons, and no radical changes were made in the equipment. To retain the good and well tried features of 600 volt control, a very simple piece of apparatus called the "dynamotor" was devised which enabled the control and auxiliary circuits to be operated at 600 volts and the main motors to use the higher potential. The only change in the motors to suit the higher voltage was that they were insulated for 1200 volts instead of 600 volts, the common arrangement being to operate two motors in series so that 600 volt windings were still used. The adoption of commutating poles on railway motors greatly facilitate the raising of the trolley potential without the introduction of complications. The marked success that attended the operation of 1200 volt apparatus under severe service conditions encouraged further steps along the same line with the result that some roads of 1500 volts were installed. The results were equally satisfactory. Most of the roads at present operating at higher direct current potentials are in the nature of interurban railways but some, however, approximated steam railroad conditions. In all cases the apparatus has proved itself as well suited to the severe conditions as the older 500 and 600 volt apparatus had. Under these circumstances it is not surprising that a still higher direct current potential should have been considered for a heavier class of service. In 1912, just five years after the first 1200 volt road was put into successful operation in this country, 2400 volt direct current was adopted as the most suitable system to meet the peculiarly severe conditions existing on the Butte, Anaconda & Pacific Railway—thus direct current apparatus has evolved from a small beginning until it has reached a stage where it meets the demands of the heaviest traction undertakings contemplated.

This is as far as we have gone at present in this direction, in actual practice, but there seem no logical reasons or limiting conditions, that we know of at present which would prohibit the use of still higher direct current potentials.

Since the initial adoption of 1200 volts, the extension of its use has been exceedingly rapid, and it may now be regarded as the standard for all new interurban railways. In some cases where marked economies can be secured 2400 volts may be used in interurban service. One example of this is already under construction, viz., the Michigan & Chicago Railway.

High voltage D.C. systems

The first road to adopt 1200 volts in this country was the Pittsburgh, Harmony, Butler & New Castle Railway. This road started operation in 1907. Since this date, the extension of high potential direct current railways has been exceedingly rapid as shown in the following table.

Date of Installation	No. of Roads	Total Road Mileage
1907	1	41
1908	2	134
1909	0	0
1910	6	424.6
1911	2	201
1912	3	196.5
1913-14	17	1061
Totals	31	2058.1

Most of the roads are in the nature of interurban railways, but it should be noted that as far as we can see the vast majority of the heavy traction work now under construction or contemplation will employ direct current apparatus and this will, in most instances, be operated on "higher potentials."

We are apparently fast coming to recognize that there is such a thing as "a science of development" and that such a science among other factors must include the following fundamentals:

(1) An accurate determination of the actual operating conditions which will enable us to settle definitely what is wanted.

(2) The co-ordination of the work of a large number of differently trained men, so that the finished product may embrace the experience of each worker in his particular line, and thus become in every detail the product of experts.

(3) The confidence and co-operation of the users and makers of apparatus both before and after its manufacture, this co-operation to continue in some form or other during the useful life of the machine.

(4) The standardization of apparatus when such will be profitable to all concerned.

Summary

(1) There are, perhaps, many who do not realize the costliness of determining what is wanted to suit a particular set of service conditions. An accurate determination of the precise requirements will often necessitate months of exhaustive investigation ,often including costly tests. This is particularly true in large undertakings. If we compare the work done in this direction to-day with the older haphazard methods of designing machinery first and seeing whether it would do the work afterwards, it is apparent that the art has benefited enormously by the work of the large corporations along these lines. Some phases of the research and development work undertaken to-day are so costly and require such a large staff of expert workers that no small engineering undertaking could shoulder the burden, as assumed by the large corporation.

(2) The proper co-ordination of the work of a host of men who are contributing to the design, manufacture and testing of electric railway apparatus is no small part of the Science of Development. The extent of this work is enormous, including as it does, preliminary proposition, final proposition, designing, drafting, actual manufacture and work incidental to following apparatus through the factory, assembling, testing, installing, and preliminary operation. The final cost of the apparatus depends largely upon whether this co-ordination of work is done in a scientific or unscientific manner.

(3) A whole paper might be read with profit on the subject of the confidence and co-operation between the user and the maker. Upon the encouragement and extension of what we might call "the modern business idea," the rapidity with which we are going to develop in the future must largely depend. The successful development of electric apparatus for traction purposes depends on "how it is made" and "how it is used." The manufacturer is dependent upon the user just as the user is dependent upon the manufacturer. An ounce of mutual confidence and co-operation will do more towards the development of the art than a ton of fault finding and mutual distrust. In the broadest sense, the aims and objects of both parties are identical. The user wants the best obtainable for his service and the maker wishes to produce the best and most efficient apparatus, as upon this his reputation and future business depends. The work of all parties concerned is in reality the part of one great plan.

(4) The correct time at which the standardization of electric apparatus should be attempted is a science in itself, e.g., it would undoubtedly be profitable to all concerned if all trolley systems would co-operate with the manufacturers in using standard apparatus, especially standard railway motors and standard control equipment, where such standards will fulfill the requirements. There will, however, always be special conditions arising that will demand special apparatus, and the things that dictate these special requirements are many and varied, e.g.: Who could have foreseen that the fashion of ladies' skirts could affect the design of railway motors? But such has been the case—the hobble skirt gave birth to the low step car—and the low step car required a new design of motor.

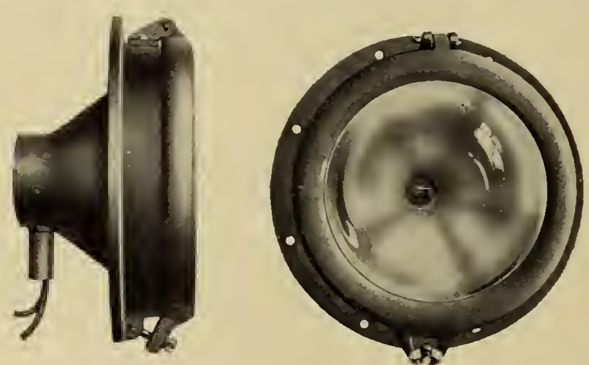
The standardization of all apparatus that is used in large quantities and has reached a high state of perfection would be a great asset to the industry.

On the other hand, until we have more experience with the different systems of electrification, it would seem unwise to lay down too definite standards for heavy traction work, although it might be profitable to standardize such things as trolley voltages that would vitally affect the future development of the art as much as the present.

In conclusion, it is well to emphasize one point, namely, that modern engineering involves, above all things, the study of economics. Yesterday we were finding out how to do things—to-day we are striving to find out how to do them more cheaply than yesterday. To combat the increased cost of living and of labor, etc., and the generally more complicated social and commercial conditions under which we are living, the work of the scientist and the engineer is to teach the world at large how to do for one dollar that which they could not do for two dollars yesterday.

New "Golden Glow" Headlights

The Esterline Company, Indianapolis, Indiana, have just added two new "Golden Glow" headlights to their line. These two types are designated as SR-95 and SE-95. While these two new headlights embody the use of the Golden Glow glass reflectors which characterize this company's products, they possess several new and important features. The lamp bodies and fronts are made entirely of pressed steel, which materially reduces the weight and improves the appearance of the headlights. In the design of these lamps the makers have taken advantage of the accuracy with which steel stampings can be made, producing a headlight which is water and dust proof. A metal ring which holds the reflector in place, also clamps a heavy gasket over which the front or door presses, making a very tight joint. The hinges and latches are designed so as to have no projecting portions, which are likely to catch wires or ropes. Another innovation is the use of electric welded joints and fastenings instead of screws or rivets. The headlights are properly ventilated in such a manner as not to admit dust or water, which prevents sweating and clouding of the reflector and front glass. Recent tests of these new headlights fitted with a 36 watt bulb on a city street, on a dark clear night, showed that the second hand of a watch can be read at a distance of 600 feet and that from the car, a man lying on the track can be seen further than is possible with an arc lamp.


New type "Golden Glow" headlight

Are Using Nitrogen Lamps

The Ontario Hydro-electric Power Commission are already making extensive use of the new type nitrogen-filled tungsten lamps. Two initial installations of approximately 500 lamps each are planned for street illumination at Hamilton and Windsor. In the former city 500 watt multiple burning lamps are to be used, and ornamental fixtures especially designed to provide the proper ventilation so necessary in connection with nitrogen lamp operation are being constructed. At Windsor the series burning nitrogen lamp will be installed and each unit will be of the 500 watt, 6.6 ampere type. These two novel installations will be followed with considerable interest, and it is safe to say that when completed the two cities will have, in point of illumination, street lighting systems equal to anything on the continent.

Personal

Mr. J. Morris has been appointed engineer-in-charge of the electric light and pumping plant of Newmarket, Ont. Mr. Morris was formerly at Mount Forest.

Mr. A. W. Ormsby, superintendent of the electric light and power department of the city of Edmonton has been east on a business trip covering Winnipeg, Chicago and other large cities.

Mr. J. H. Ward formerly of Tottenham, has been appointed electrician in charge of the electric plant at Acton, where power is obtained from the Guelph sub-station of the Niagara system.

Mr. F. M. Tupper who has been connected with the Allis-Chalmers-Bullock Company, for the last eight and one-half years in Winnipeg and Calgary, has joined the sales force of the Moloney Electric Company of Canada. Mr. Tupper will be district manager of the Winnipeg office.

Mr. Thos. Henry has been appointed electrical inspector for the city of Toronto. Mr. Henry has for years held the position of Chief Engineer of the Interurban Electric Co.

Mr. William O'Hara, chief engineer of the Newmarket electric light and power department has resigned.

New Books

Molded Electrical Insulation and Plastics—by Emil Hemming; Ward Clausen Company, publishers, 200 Fifth Ave., New York. The purpose of this book is to deal with the progress of moulded insulation, to trace its development during the last ten years and to discuss its present status; to treat of the important basic principles of the new products and inventions omitting specific trade names; to give the engineer an insight into materials and methods employed in manufacture, disclosing various characteristics, favorable and unfavorable; and so to guide him to a proper selection of the substance best suited to his wants and requirements. The book includes a number of helpful illustrations.

Electric Light Accounts and Their Significance—By H. M. Edwards, auditor New York Edison Company; McGraw-Hill Book Company, Inc., publishers; price $2.00. The author has been connected for many years with the New York Edison Company and with the accounting end of the National Electric Light Association. As a result the system of accounting advocated in his book is in most respects similar to the systems adopted by these two organizations. The preface points out that a modern public service corporation urgently needs a system of accounting which will enable it to keep track of its affairs and from which all necessary information may be obtained either by those charged with the conduct, of the corporation or by the authority under whose jurisdiction it happens to be operated. It is believed that this book contains a description of such a system of accounts as designed specially for an electric light company. Attractively bound in soft leather covers; size 5-in. x 7½-in.; 172 pages.

The Montreal Tramways Company are appealing to the Privy Council against a decision of the Appeals Court holding that the Quebec Public Utilities Commission have power to order the company to furnish details of equipment, running schedules, service, and their relations with the city.

The Dealer and Contractor

Daylighting Scribner's Book Store

The remarkable daylight effect produced in Scribner's new store on 5th Ave., New York, is a revelation of what can be done through the proper application of laws governing scientific illumination. The arched ceiling effect, which forms the principal architectural feature of this store, is a soft cream white color, and is embellished with a series of simple but rich panel designs. The surface of these arches forms one of the most perfect light-reflecting mediums possible to obtain in architectural construction. At the base of each arch is installed a powerful reflector that throws a strong white light upward. This light spreads over walls and ceiling and is reflected downward, diffusing a mellow glow of pure white light over the innumerable tables, shelves and cabinets filled with many colored volumes.

The light produced by this system is practically a reproduction of daylight, with the result that the finest details are plainly visible, while the most delicate colors can be seen in their true values. This is particularly noticeable when inspecting some of the rare old volumes found in the store, for Scribners have quite a collection of first editions and originals, a few of which are,—one of the earliest Shakespearian folios, a first edition of "Gulliver's Travels," Napoleonic manuscripts in French and English, and letters of Mary, Queen of Scots. Another interesting rarity on view is a first edition of Goldsmith's "Vicar of Wakefield."

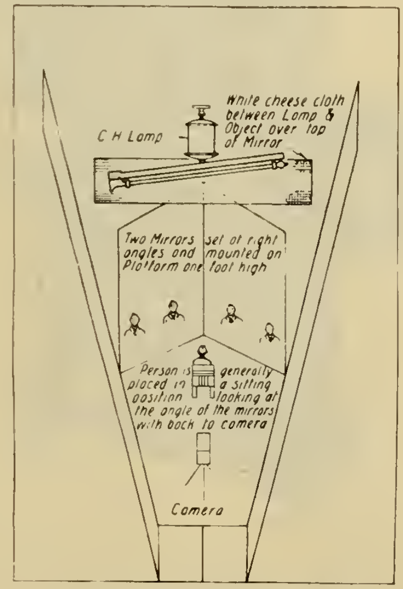
Good example of book-store lighting.

The illuminating scheme of this beautiful store is finished with a series of elaborate lamps that hang from the ceiling on chain drops at a distance of about fifteen or twenty feet apart. The powerful lamps used at the base of the arches for indirect or cove lighting are the J-M Linolite lamps. They are about a foot long and an inch in diameter, and have a straight tungsten filament that runs from end to end. This filament produces a continuous "line of light" that diffuses the illumination evenly over the entire surface to be lighted—in marked contrast to the spotty effect produced by the bulb type of lamp.

Multiple Photographs

The scheme of showing in a photograph four or five likenesses of one individual has always proved an attractive one because of a certain air of mystery surrounding it. To the average person it is quite mystifying how the different poses can be secured of the same individual all on one plate. The attached sketch shows how this may be effected.

There are two special mirrors with frames only on three sides each five feet high and three feet wide placed at a 72 deg. angle to each other, the angle being formed by the edges of the glass alone. The subject sits at a table with his back to the camera, facing the angle formed by the mirrors. The camera then points at the back of his head, and the reproduction obtained from the combination of the mirrors results in showing on the plate a reproduction which looks as if five men were sitting at the table, each an exact duplicate of the other. Frequently, the subject is photographed playing cards, and this results in a view of five men, exactly the same in appearance, playing a game of cards with each other.


White cheese cloth between Lamp & Object over top of Mirror
C H Lamp
Two Mirrors set at right angles and mounted on Platform one foot high
Person is generally placed in a sitting position looking at the angle of the mirrors with back to camera
Camera

How multiple photographs are made.

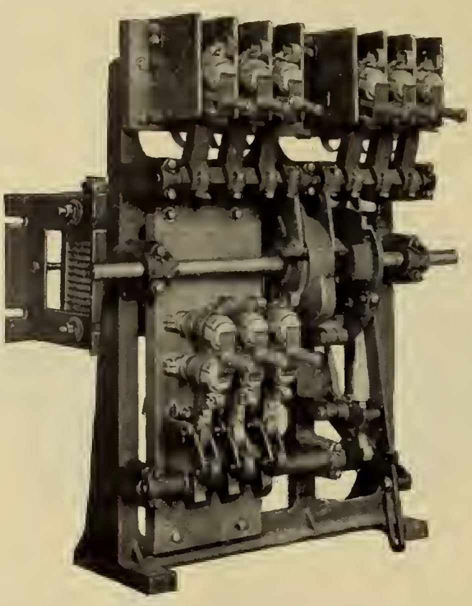
Not the least important feature of this scheme is that of securing the right light with the proper diffusion. In this case, the well-known Cooper Hewitt lamp is suspended directly over the man's head, and about half way between the location of the man and the mirrors. White cheese cloth is placed between the lamp and the object over the top of the mirrors in order to further increase the diffusion. The accompanying illustration shows how the scheme may be worked out.

The Hydro-electric Power Commission have awarded contracts for the construction of distribution stations at Creemore, Port McNicol, Waubaushene, Strathroy, Tilbury.

New Elevator Controller for A.C. Equipment

Because of the extensive use of central station service many buildings, factories and industrial plants use alternating current for lighting and power, including the elevator drives. In many plants where an electrician or high grade engineer is not available for making adjustments, there has been a tendency to favor the use of a.c. elevator controllers which do not employ any solenoid-operated switches. To meet this demand with a high grade controller embodying straight mechanical operation The Cutler-Hammer Manufacturing Company of Milwaukee have added to their line of a.c. automatic and semi-automatic elevator controllers a full mechanical type which meets the needs of many equipments. This controller is made for use with polyphase slip-ring induction motors and has no electro-magnets or sliding contacts. It is arranged for operation from the car by either rope or lever, the shaft having an extension at each end so that the controller can be adapted for either right hand or left hand operation. This controller has the further advantage of operating satisfactorily on circuits having a very wide voltage variation.

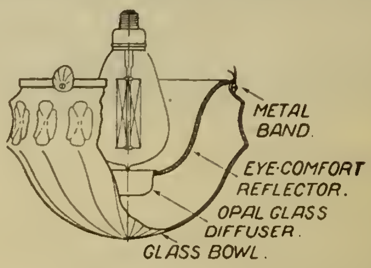
The primary circuit is controlled by two sets of switches, each set consisting of three single-pole switches, equipped with arcing shields. Each set of primary switches is operated by a special internal cam, arranged so as to give an absolute "knock out" to the switches when opening, and also an absolute "lock out" for the second set of switches, when the first set is thrown in. The secondary resistance is cut out by three triple-pole cam-operated switches. Immediately after the primary switches are thrown in a catch is released, allowing a weight to drop, the motion of which is retarded by a suction dash-pot. This weight in turn drives a shaft on which the necessary cams are mounted for throwing in the secondary switches. The secondary resistance is cut out simultaneously in all three phases of the rotor circuit, thus insuring a balanced condition at all times. The secondary resistance is re-inserted upon the opening of the primary switches and a latching arrangement is also provided so as to prevent accidental operation of the controller, if the operating mechanism is not thrown to the central position. The type of electrical "butt" type contact is the same throughout thus simplifying renewal of parts subject to wear. All of the contacts have a wide range of adjustment, thereby giving maximum life. A notched star wheel gives an accurate indication of the "off" and "running" positions.



Controller for a. c. elevator operation.

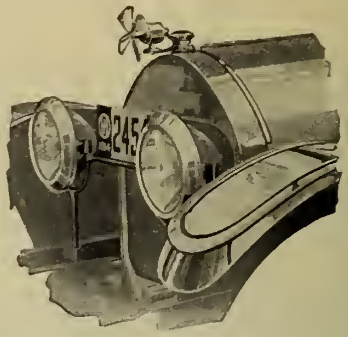
Eye Comfort Luminous Bowl

The accompanying illustration shows the "Eye Comfort" luminous bowl principle. By means of a powerful one-piece silvered glass reflector the light from the lamp is directed to the ceiling at the proper angle. From the ceiling the light is diffused evenly throughout the entire room. eliminating all glare and sharp shadows. The small portion of light which comes through the opening in the bottom of the reflector is redirected by an especially designed opal glass diffuser so as to evenly and softly illuminate the glass bowl for decorative effects. No useful light reaches the working plane directly through the glass bowl.



Automobile Novelty Fan

As a feature of their advertising helps for electrical dealers and contractors, The Robbins & Myers Company, Springfield, O., have made up a small novelty fan which can be mounted on the radiator of a motor car, as shown by the illustration. The fan spins by the air current created by the motion of the car, even when the car is running slowly. Being symbolical of the electrical trade, it makes a dignified advertisement which appeals to every electrical dealer or contractor who has a motor car. The base of the fan is tapped for a stud bolt, and the usual method of mounting it on the car is to tap the cap which covers the opening to the radiator and mount the fan directly on this cap. Another method which can be followed is to mount the fan on an iron strap which is clamped around the cap, as shown in the illustration above. The fan can be furnished with either nickel or brushed brass finish.



Northern White Cedar Association

An exhibit of Northern White cedar poles, posts and ties is being shown by the Northern White Cedar Association at the Grand Central Palace, New York, from May 21 to 30 inclusive. The object of the exhibit is to demonstrate the durability of this wood. Included are telephone poles of Northern White cedar which have been in actual service for fifty years and which were removed from the line only for this exhibit. Ties are also shown which have been in use for 29 years. It is claimed that this timber is unexcelled in strength, lightness, durability and good appearance. The object of the Association is to establish grades of poles, posts, ties and shingles which will be standard and to maintain these grades, so that purchasers may be assured of procuring material for their particular purposes. A similar exhibit was held in Chicago during the first week in May.

A New Type of Sign

The accompanying illustrations represent night and day views of a very attractive—and attracting—sign installed on King Street East, Toronto. The sign was manufactured by the Ontario Sign Company, Toronto, and is equipped with their new invention, a spherical type bull's eye. This bull's eye is now superceding the disc form originally adopted on account of the greater efficiency of signs equipped with them. Experiments show that it only requires approximately one-half the illuminating capacity to operate these signs as compared with the older type of signs using discs.

Day view of sign equipped with bull's eyes.

Night view of new sign.

Mr. C. C. Mendham who has been connected with the outdoor staff in Toronto of the Herbert Morris Crane & Hoist Company, Limited, has now been appointed resident engineer in Berlin for the same company. This appointment is in line with the policy of this company which consists not only in carrying large stocks of their manufacture to ensure prompt delivery, but in furnishing also a consulting engineering service which will advise on the best equipment for any given set of conditions.

By amendments to the Power Commission Act, Ontario townships are now able to make contracts for the supply of hydro-electric energy without submitting a by-law to the ratepayers. All that is necessary is a petition signed by a majority of the freeholders.

New Companies

The Munder Tungsten Lamp Company has obtained an Ontario charter, capital $50,000, head office Guelph.

The Gowganda Power Company, Limited, has been incorporated with head office Gowganda, and capital $1,000,000

The Northern Interior Light & Power Company, Limited, has been incorporated with head office Fort George, B.C., and capital $50,000.

The Weno Power and Light Company, Limited, has been incorporated with head office Calgary, and capital $100,000.

The St. Thomas Electric Company, Limited, has been incorporated with head office St. Thomas, Ont., and capital $40,000.

The Automatic Electrical Heat Controller Company, Limited, has been incorporated with head office Vancouver and capital $200,000.

The Automatic Telephone Manufacturing Company of Canada, Limited, has been incorporated, capital $1,000,000, head office Winnipeg.

Trade Inquiries

368. **Electrical machinery.**—South American firm inquires for electrical machinery.

Trade Publications

Oil Fuse Cutouts—Circular 150 issued by the D. & W. Fuse Company, Providence, R.I., describing oil fuse cut-outs for high tension work.

Auto-Manuel—Booklet issued by the North Electric Company, Cleveland, Ohio, entitled "Auto-manuel described for the practical telephone man."

Railway Signals—Catalogue Section B, Part 7, issued by the General Railway Signal Company of Rochester dealing with R. S. A. mechanical dwarf signals.

Transformers—Cotalogue just issued by the Moloney Electric Company, Windsor, describing and illustrating in detail the various steps in the construction of Moloney transformers.

Canadian Westinghouse—have issued circular No. 1137 describing and illustrating the construction of their watt-hour meters for alternating and direct current; also folder 4284, describing Westinghouse Railway Lightning Protection; also folder 4197 entitled Electrical Household Helps.

Isolated Power Plants—The Canadian General Electric Company have issued catalogues covering electric plants for lighting and power at isolated points. One of the features of this plant is the use, as auxiliaries, of chloride accumulator batteries. The catalogs cover installations both at the ordinary voltage of 110 and at lower voltages down to 32 volts.

Illuminating Industrial Plants—The Canadian General Electric Company have issued two attractive and informing bulletins dealing respectively with the lighting of woodworking plants and the lighting of machine shops and metal working plants. These are both well illustrated and contain much valuable information.

Overhead Runways—The Herbert Morris Crane & Hoist Company have issued a descriptive pamphlet dealing with the Morirs overhead runway. Interesting illustrations represent very graphically how a lot of money can be thrown away in shifting loads which can be handled more economically and much more expeditiously with the proper runway equipment.

Condulets—A complete catalogue issued by the Crouse-Hinds Company of Canada describing their almost infinite number of types of condulets. The catalogue is splendidly illustrated, much of it in two and three colors. This is in reality a complete treatise on the subject of condulets covering some 210 pages, 9-in x 12-in. size; bound in stiff covers.

Current News and Notes

Amherst, N.S.

The annual report of the Maritime Coal, Railway & Power Company, Limited, shows gross profits for the year of $116,959, an increase of 16.5 per cent. over the previous year. The report states that the main power station at Chignecto has been enlarged during the year by the addition of a 1,000 kw. steam turbo-generator. Also a new concrete dam for power purposes has been built, a supplementary transmission line to Amherst constructed and a new sub-station built and equipped with 1,000 .kw. transformer capacity.

Bathurst, N.B.

The Bathurst Lumber Company are equipping their new planing mill with motor drives. About 300 kw. is being installed.

The Bathurst Pulp Company are getting out plans for a large pulp and paper mill. This plant will be electrically-operated throughout. Three 750 kw., 550 volt a.c. turbo-generators will be installed in the power house. It is expected that the plant will be in operation about November 1st. Mr. McDairmid of the Montreal Light, Heat & Power Company, is consulting engineer for both the pulp and lumber company.

Calgary, Alta.

A by-law was defeated on May 11th which asked authorization to spend $300,000 on electric light extensions.

Charlottetown, P.E.I.

The Charlottetown Light and Power Company are changing over their entire system from 133 to 60 cycles and, starting June 1st, will operate a 24-hour system. They have for the past few years been operating both steam and gas engines in their power house, but after the change is completed the entire equipment will be operated by gas engines. Mr. Thos. Coleman is the superintendent in charge of the plant.

Cheltenham, Ont.

The International Brick Company has made a contract with the local Hydro-electric Power Commission for the supply of 200 h.p. This point is served from Georgetown.

Duncan, B.C.

A 200 h.p. Diesel plant is being installed in Duncan, B.C. It is expected to be in operation by September 1 of the present year. It has been announced that the rates will be reduced to 15c for the first 50 kw.h., 12½c for the second 50 kw.h., and 10c for all in excess of this amount with 20 per cent. discount and a monthly meter rental of 20c.

Edmonton, Alta.

Contracts have been awarded by the city commissioners to Babcock and Wilcox for the construction and complete equipment of a new boiler house at the power plant at a cost of $183,800. This is one of the improvements planned by the commissioner of operation, the cost of which is taken out of the obsolescence fund set aside during the past eighteen months.

Edson, Alta.

The town of Edson carried a by-law last year authorizing the expenditure of $45,000 on an electric light and power plant. Owing to the condition of the financial market they were not able to dispose of their debentures to advantage at that time, but we understand that these have now been sold and that work will proceed on the erection of this plant.

Embro, Ont.

A by-law was recently carried authorizing the expenditure of $6,000 for a power distribution system to connect up with a Niagara supply.

Fort William, Ont.

The extensions to Fort William's municipally-owned street railway were commenced a few days ago, and during this summer there will be quite a large programme of construction work carried on. The first work to be undertaken will be the construction of the new belt line along North Syndicate and Pacific avenues, and Victoria Avenue west to Franklin, and Franklin Street south to Walsh Street. The street railway extension to the Island across the Bascule lift bridge is practically completed, and all there remains to be done is a few connections that will be fully completed before the end of May.

Grenfell, Sask.

Permission has been granted by the local government to the town of Grenfell, Sask., to issue debentures to the amount of $6,500 to be spent on extensions to their electric light plant.

Guelph, Ont.

The Hydro-electric Power Commission have decided on a reduction of approximately 10 per cent. on the local rates.

Hagersville, Ont.

Extensions to the electric system are contemplated by the village council.

Hantsport, N.S.

The new municipal lighting plant in this town will be in operation by June 1st and is expected to furnish light and power at a very cheap rate. The apparatus is being installed at D. W. Murray's woodworking factory. Refuse from the mill will be used as fuel. The electrical apparatus is being furnished by the Canadian General Electric Company. Leonard & Son are furnishing the steam equipment.

Kamloops, B.C.

Tenders are called for the construction of a reinforced concrete power house to be built for the Barriere River hydro-electric development for the city of Kamloops. Messrs. Ducane, Dutcher & Company, Vancouver, are consulting engineers.

Leduc, Alta.

The town of Leduc has awarded a contract to the Canadian Westinghouse Company for a 50 kw. generator and switchboard equipment and to the Canadian General Electric Company for all material required in approximately four miles of pole line. It is expected this plant will be ready for operation in August of this year. The contract for the steam equipment has not yet been reported, but it is expected that vertical high speed engines and horizontal return tubular boilers will be used.

Lachine, Que.

The council of Lachine, P.Q., have passed a by-law to expend $600,000 on civic works, including underground conduits for electric wires.

Little Current, Ont.

The property owners of Little Current on May 4th voted in favor of establishing a municipal electric plant to cost in the neighborhood of $12,000.

Moncton, N.B.

The Moncton Tramways, Electricity & Gas Company will make a number of changes in their plant this year. A 200 kw. synchronous motor-generator set will be installed in the power house to take care of their tramway load. Several will be added . Power lines will be built to the new city additional miles of track will be built and three new cars pumping plant where two 75 h.p. electrically driven pumps are being installed. Judging from the amount of building under way at present this should be a good year for the electrical business in Moncton.

Montreal, Que.

Plans have been prepared by the Electrical Service Commission, Montreal, for three additional streets—Craig, St. James, and a portion of Notre Dame, and tenders for the work will be called in June.

The Standard Underground Cable Company of Canada, Limited, Hamilton, Ont., have received orders from the Montreal Public Service Corporation and the Montreal Tramways Company for over 200,000 feet of cable. This will be used in connection with the underground conduits on St. Catherine and Bleury streets, constructed by Mr. G. M. Gest for the civic Electrical Service Commission. The city now requires that all wires be placed underground.

An order for a switchboard has been given to the Canadian Westinghouse Company by the Canadian Light and Power Company. This is part of the new generator equipment which is being installed at the company's plant at St Timothee, P.Q. The new unit will have a capacity of 5,000 kv.a. under a 48-ft. head.

The first order for a British cable for the United States has been received by the British Insulated and Helsby Cables, Limited, Prescott, England, with which the Canadian British Insulated Company, Montreal, is affiliated. The order is for 55,000 feet of 3-phase, 25,000 volt, .1 square inch split conductor cable, and was received from the Edison Electric Illuminating Company of Boston. Approximately half the cable is single wire, armoured, finished with Merz tapes and the balance plain lead covered. The cable is to be laid under the supervision of the British company.

The Montreal Harbour Commissioners have made a contract with Darling Bros., Limited, Montreal, for two electric hoists, similar to the one recently installed. They will each have a lifting capacity of 30,000 pounds.

The Montreal and Southern Counties Railway have opened their extension to St. Cesaire, a distance of 31 miles from Montreal. The further extension to Granby will be built this year.

Nelson, B.C.

Negotiations are being carried on between the Johnson Electric Smelting Company and the city regarding the establishment of a plant in Nelson. The Johnson process is a recent invention for the electric reduction of zinc ores.

Newcastle, N.B.

The power plant in connection with the Universal Radio Syndicate, Limited, wireless station was put in successful operation during the month of April. This is an installation of two 250 h.p. three cylinder vertical oil engines direct connected to 150 kw. 1100 volt, direct current generators. The current from these machines is carried in ducts to the operating house which is located about 2,000 ft. away from the generators. A 15 kw. motor-generator set is installed for lighting and charging storage batteries. All towers, guy and aerial wires are insulated for 60,000 volts. The oil engines were built by the Franco Fosi Company of Lagano, Italy, and the generators and switchboard by the Insulated Rubber and Gutta Percha Works of London, Eng. The company expect to have the plant in commercial operation about June 1st.

Ottawa, Ont.

The Carling Exchange, Ottawa, of the Bell Telephone Company, will be cut in about June 15th. The exchange is constructed to take care of additional business.

The Canadian Street Railway Association is holding its annual convention in Ottawa, May 13 and 14.

The W. C. Edwards' bill asking permission to sell surplus electric energy in and around Ottawa has been modified to the extent that the rates have been placed under the control of the Hydro-electric Power Commission of Ontario.

Point Edward, Ont.

Mr. H. A. McLean, engineer to the town of Sarnia, has recently placed an order with the Herbert Norris Crane & Hoist Company for one of their standard type G hand operated overhead traveling cranes. This crane will have a capacity of 10 tons and a span of 49 ft. 3 in. The crane is to be used in the new pump house at Point Edward.

Port Coquitlam, B.C.

It is reported that the McNairn Lumber Company will install an electric lighting system throughout their camps along the Coquitlam River. It is stated that they will also install a telephone system connecting the various camps and the mill. Power for electric light has been secured from the B. C. E. R. Co.

Port Elgin, Ont.

The annual meeting of the Bruce municipal telephone system shows assets of $95,464. There are approximately 1,000 telephones now in use and the rate charged is $12.50 per annum.

Port Hawkesbury, N.S.

There is a movement on foot to install an electric lighting plant in this town. At present the North Atlantic Fisheries Company have a 50 kw. outfit installed at their cold storage plant and it is proposed that they operate a lighting system for the town.

Prince Albert, Sask.

A proposition has been received from an Ottawa syndicate regarding the construction of a street railway system in Prince Albert. The syndicate ask for a twenty-year franchise.

Plans and specifications for a new telephone building have been prepared by Storey & Van Egmond, architects, Regina, and the contract for the erection of the building has been let to the McKay Construction Company, Regina. The building is being constructed by the Saskatchewan government and is very similar to the building recently erected in Regina. It will be of steel construction with reinforced floors, walls of brick with stone trim, two storeys and basement. The automatic system of telephones will be installed.

Regina, Sask.

The operation returns for the municipal street railway system, Regina, for the week ending April 18th, are as follows:—revenue $3,757.15; passengers carried 87,752; passengers carried including transfers, 98,632. For the week ending April 25 corresponding figures are $4,145.50, 97,358 and 109,866. For the week ending May 2, the returns are $3,696.10; 88,811; 99,686.

The following companies have been authorized to borrow money for telephone systems:—Guernsey Rural Telephone Company, Limited, $10,500; Goodwater Rural Telephone Company, Limited, $6,000; Ideal Rural Telephone Company, Limited, $7,800; Adanac Rural Telephone Company, Limited, $5,500; Forward Rural Telephone Company, Limited. $7,500; West Froude Rural Telephone Company, Limited, $3,700; Dumas Kennedy Rural Telephone Company, Limited, $2,000; Willsmer Rural Telephone Company, Limited, $6,800; Ardine Rural Telephone Company, Limited, $2,500.

Sackville, N.B.

The Eastern Electric & Development Company who operate the light and power service in this town recently applied to the Public Utilities Commission of New Brunswick for permission to increase their rates. A number of sessions of the Commission wehe held and their decision was against the increase in rates. A new hearing will likely be asked for.

Saskatoon, Sask.

A by-law was recently defeated which asked authorization to expend $200,000 on electric power house and electric distribution extensions.

Stellarton, N.S.

The corporation of Stellarton is making extensive additions to their plant and after June 1st will operate a 24-hour power service. Orders have been placed covering one 187½ kv.a., 3-phase, 2,200 volt, 60-cycle generator with generator and feeder panels; also one 250 h.p. turbine water wheel and material for five miles of power line. The operation of the plant during the past three years has been remarkably successful while the rate for lights is possibly the lowest in eastern Canada. Gideon Dexter is the superintendent in charge of the plant.

St. John, N.B.

The application of the St. John Hydro-electric Company for an extension of time to begin work on the erection of a dam across the St. John River above Fredericton to develop power on a large scale has been rejected by the local legislature. The St. John Railway Company were also refused authority to make a new issue of bonds as the amount already authorized has not all been taken up.

The St. John Street Railway Company have awarded a contract for the building of a new car barn to A. R. C. Clarke & Son. The building is to be 115 ft. x 58 ft., of steel and brick construction.

Stouffville, Ont.

The town council have issued orders to the superintendent to reconstruct part of the distribution system.

St. Stephen, N.B.

The St. Croix Gas Company have recently put in operation a 24-hour service and are building up a very substantial power load. This company operates a water power plant and furnishes light and power to the four towns of Calais and Milltown, Maine, U.S.A., and St. Stephen and Milltown, N.B. It is understood that the Calais Street Railway Company who operate a tramway line in these towns will also enter the power field and install additional apparatus and extend their a.c. power lines. This latter company are at present supplying power from their trolley line at 500 volts to several of the factories in St. Stephen.

Stratford, Ont.

A by-law will be submitted on May 18 authorizing the expenditure of a further $22,000 on the street lighting system.

A by-law will be submitted on May 18 asking authority to purchase additional fire equipment at a cost of $17,250.

Swift Current, Sask.

A contract has been awarded to the Gilstrom Contracting Company for the erection of an electric power house.

Toronto, Ont.

A bill has been introduced in the local legislature amending the Telephone Act. Power is now given the Ontario Railway & Municipal Board to prevent unnecessary duplication of telephone systems, to regulate the hours of employment of telephone operators and to approve agreements of interchange of traffic, sale of telephone companies, etc.

Vancouver, B.C.

The new Vancouver hotel named Hotel Vancouver will be equipped with more than 750 telephones.

It is stated that the J. Z. Lajoie Company, the incorporation of which was recently reported in the Electrical News, is a subsidiary of the Canadian Northern Railway Company and the purpose of the new organization is to develop the Lajoie Falls to supply power for the operation of the C. N. R. tunnel now under construction.

Vernon, B.C.

The installation of a 525 h.p. Diesel engine generator set is at present under way in the Vernon power house.

Wallaceburg, Ont.

The local company have offered to sell out the electrical end of their plant to the town for $30,000 and a by-law will be submitted in the near future.

Wapella, Sask.

The Brookside Rural Telephone Company are calling tenders for the construction of their system.

Windsor, Ont.

The Canadian British Insulated Company, Montreal, have closed an order with the Corporation of Windsor for 10 miles of single conductor 4000 volt armored cable.

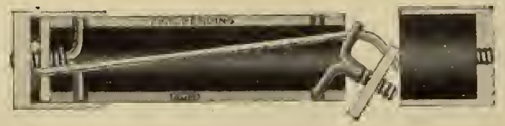
Winnipeg, Man.

Proposed extensions to the street lighting system being discussed at the present time include an installation of ornamental standards on Portage Ave. from Carlton to Maryland.

Wolseley, Sask.

A by-law will be submitted on May 29th authorizing certain extensions to the electric light system of the town

DAUM REFILLABLE FUSES



Refilled by simply bending the fuse over the metal cross piece and screwing the cap in place.

No threads on the fibre tube to strip off or screws, rivets or clamps to get loose. Merely two holes in the fibre tube and held in place by the cap. This metal to metal contact is not affected by the swelling or shrinking of the fibre shell.

Daum Fuses are making good every day.

CATALOGUE NO. 17 for the asking

Sole Manufacturers

A. F. DAUM COMPANY, PITTSBURGH, PA.

ASK US about

Efficient

Lighting

for your streets, factory, warehouse or yard

A. H. WINTER JOYNER, Ltd.

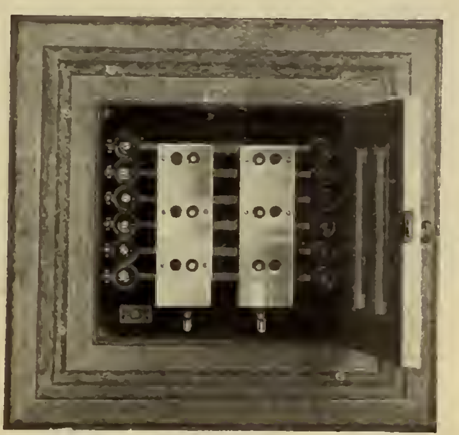
76 Bay Street, Toronto

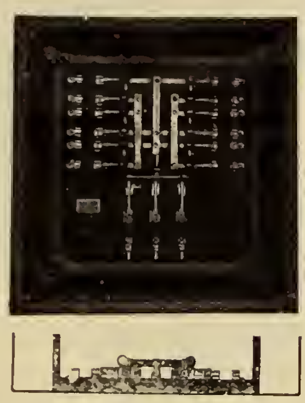
"Consult A Specialist"

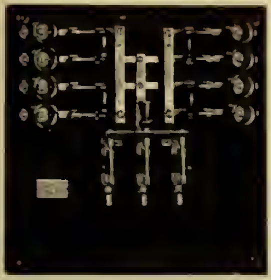
TRUMBULL

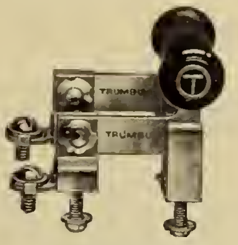
Cabinets Panels Switches

Cabinet Complete (showing knockouts and conduit hole closer)


Push Switch Panel and Cabinet complete. The latest in high grade design

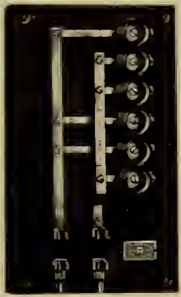

Panel and Box only

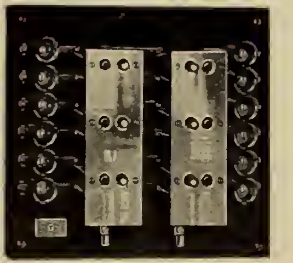

Panel for Plug Fuses

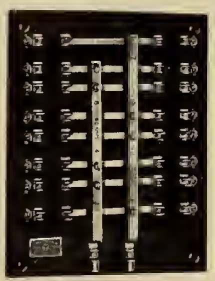


Panel Switch

Snap Switch Panel


Single Branch Panel


Push Switch Panel without Cabinet


Panel for Enclosed Fuses

All newly designed with many valuable adjustable features—all shown in Catalogue No. 10. Get catalogue and investigate.

The Trumbull Electric Mfg. Co.

Plainville, Conn., U.S.A.

Condensed Department

Publisher's Notice

Advertisements under "Situation Wanted" "Situation Vacant" or Miscellaneous, are charged at 2 cents a word per insertion, minimum charge 50 cents.

Advertisements for tenders, equipment, wanted or for sale, etc., are charged at $2.10 per inch.

All advertisements must be in the publisher's hands by the 10th or 23rd of the month to insure insertion in the subsequent issue.

Experienced Engineer

Electrical and Mechanical Engineer, Associate A.I.E.E., technical graduate, open for engagement. Wide experience. Employed at present. Address Box 14, Electrical News, Toronto. 9-10

Electrical Engineer

Position Wanted—Electrical Engineer, Associate A. I. E. E., age 33. Thirteen years' practical experience with D.C. and A.C. machinery, Accumulators, Line erection and maintenance, High speed steam engines and water power plants. At present in charge of Suction gas plant. Box 11, Electrical News, Toronto. 9-13

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Bought, sold, rented, and exchanged. We have the largest stock in America. Send for our monthly bargain sheet showing complete stock with our prices.

GREGORY ELECTRIC CO.
CHICAGO, ILLINOIS
Established 1893

Electrical Machinery

Motors, Dynamos, Generators,
Electrical Pumps and Supplies.
Electrical Contractors.
Motor Repairs.

MAC ELECTRIC CO

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CANADIAN OFFICE & SCHOOL FURNITURE CO. LIMITED
PRESTON ONT.
FINE BANK, OFFICE, COURT HOUSE & DRUG STORE FITTINGS.
OFFICE, SCHOOL, CHURCH & LODGE FURNITURE
SEND FOR CATALOGUE

Lighting Schedule for June, 1914

Courtesy of the National Carbon Company, Cleveland.

Date.	Light.	Date.	Extinguish.	No. of Hours
June 1	11 20	June 2	3 50	4 30
2	11 50	3	3 50	4 00
4	0 10	4	3 50	3 40
5	0 40	5	3 50	3 10
6	1 10	7	3 50	2 40
7	No Light	8	No Light	
8	No Light	8	No Light	
9	8 00	9	11 10	3 10
10	8 00	10	11 50	3 50
11	8 00	12	0 20	4 20
12	8 00	13	0 50	4 50
13	8 00	14	1 10	5 10
14	8 00	15	1 30	5 30
15	8 00	16	1 50	5 50
16	8 00	17	2 10	6 10
17	8 00	18	2 30	6 30
18	8 00	19	2 50	6 50
19	8 00	20	3 10	7 10
20	8 00	21	3 50	7 50
21	8 00	22	3 50	7 50
22	8 00	23	3 50	7 50
23	8 00	24	3 50	7 50
24	8 00	25	3 50	7 50
25	8 00	26	3 50	7 50
26	8 00	27	3 50	7 50
27	6 00	28	3 50	7 50
28	8 00	29	3 50	7 50
29	10 00	30	3 50	5 50
30	10 20	July 1	3 50	5 30

Total Hours 159 10

Toronto & Hamilton Electric Company
HAMILTON

Offer for sale the following

Second-Hand Motors

2—50 H.P. Type C. Westinghouse, 2 phase, 60 cycle, 220 volts, 900 Rev. Starter, rails and pulley.
1—20 H.P. Type C. Westinghouse, 2 phase, 60 cycle, 220 volts, 900 Rev. Starter, rails and pulley.
1—20 H.P. Type CCL Westinghouse, 2 phase, 60 cycle, 220 volts, Starter, rails and pulley, 1200 Rev.
1— 5 H.P. Type CCL Westinghouse, 2 phase, 60 cycle, 220 volts, 1800 Rev.
1— 1 H.P. Type CCL Westinghouse, 2 phase, 60 cycle, 220 volts, 1800 Rev.
1— 3 H.P. Type KQ C.G.E. 2 phase, 60 cycle, 220 volts, 1800 Rev.
2— 2 H.P. Type 1G C.G.E., 2 phase, 60 cycle, 220 volts, 1800 Rev.
6— 1 H.P. Type S T.H.E., 2 phase, 60 cycle, 220 volts, 1800 Rev.
4— 2 H.P. Type S T.H.E., 2 phase, 60 cycle, 220 volts, 1800 Rev.
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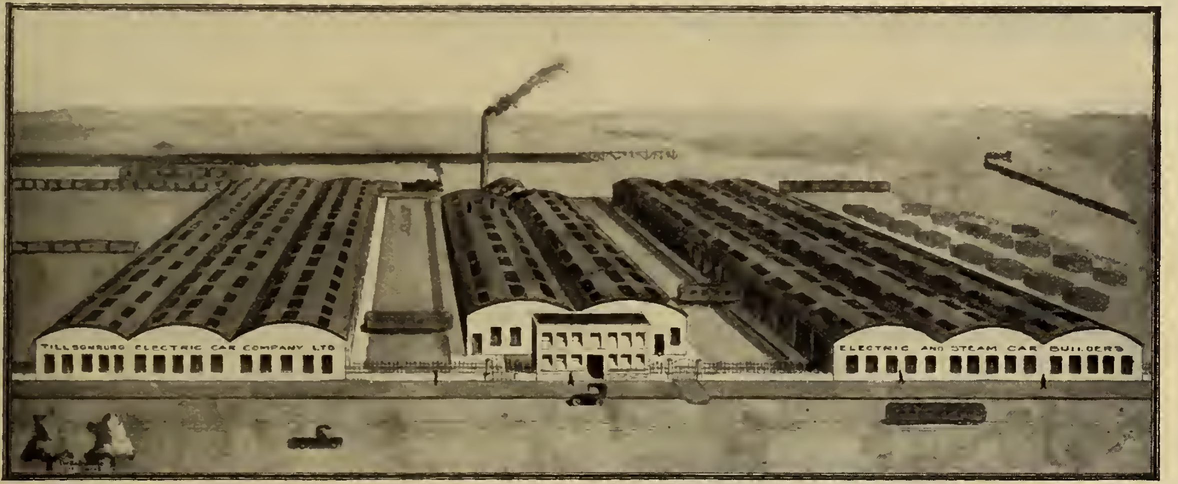
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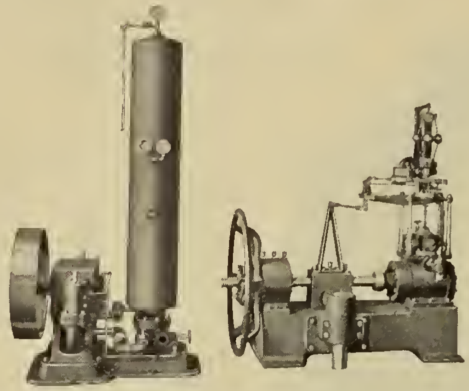

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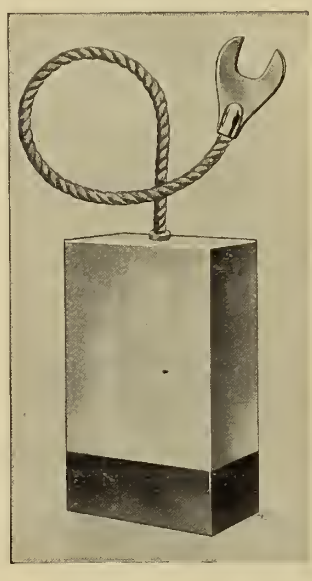

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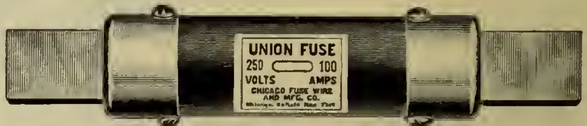

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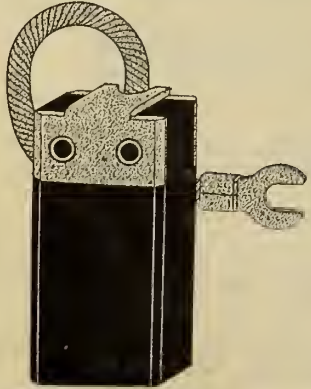

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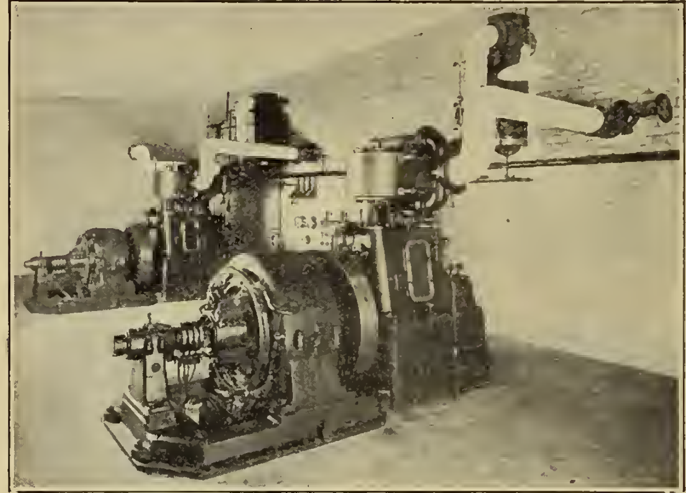

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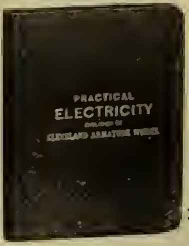

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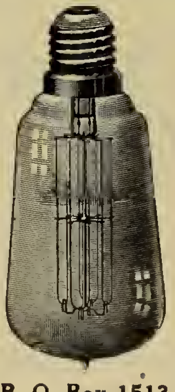

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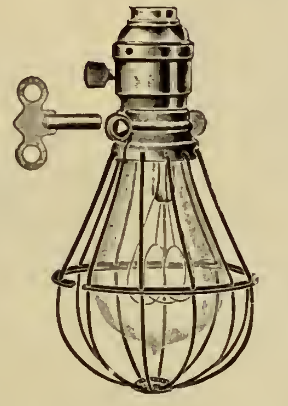

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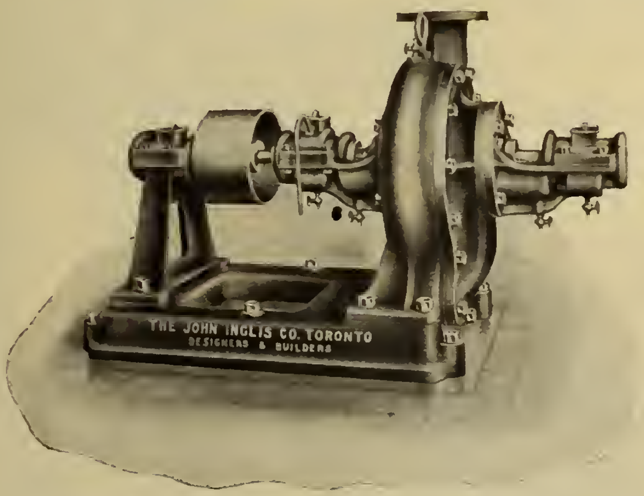

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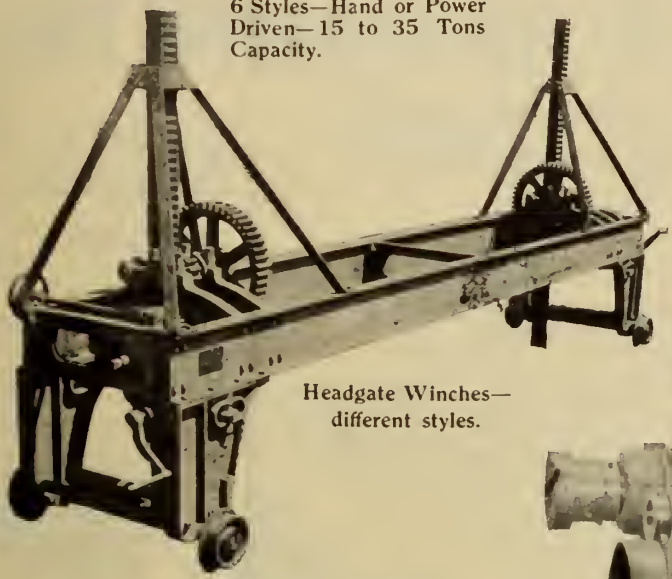

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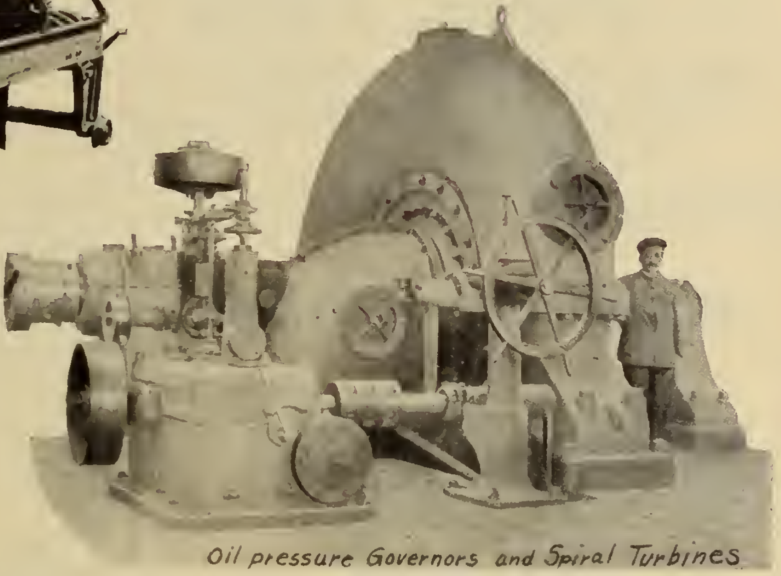

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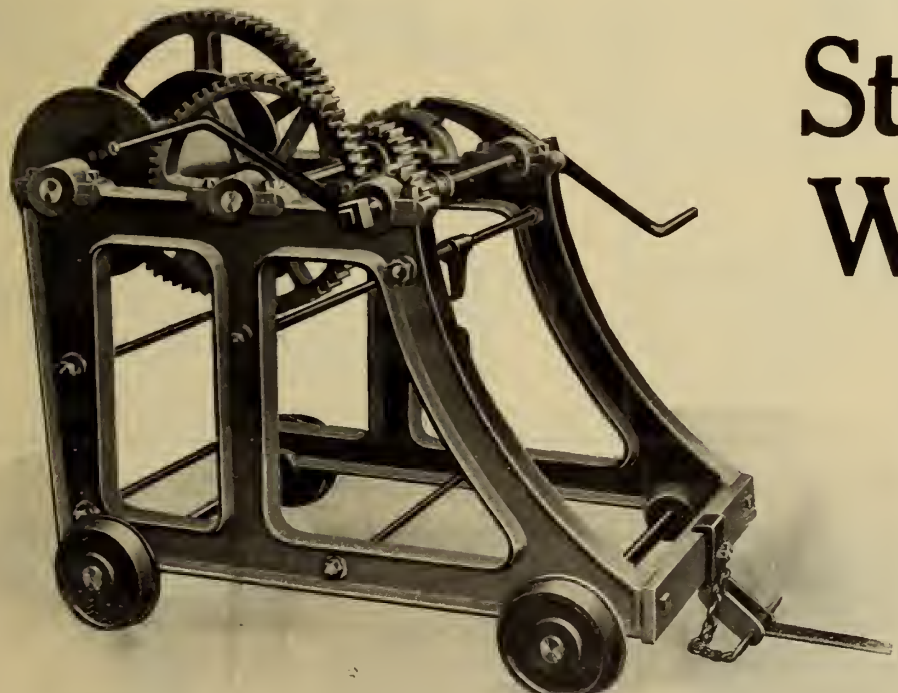

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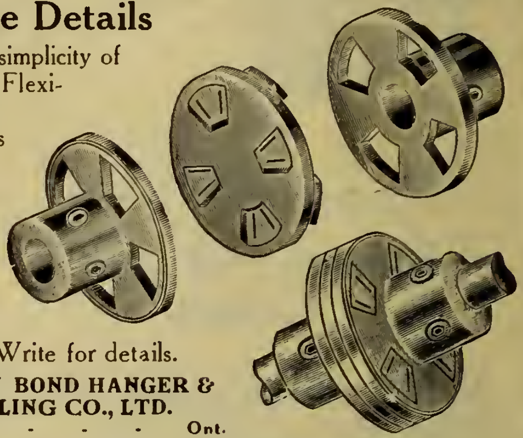

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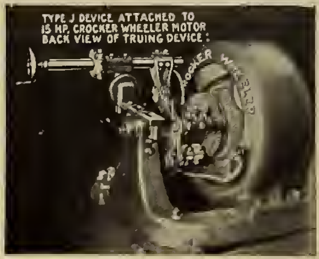
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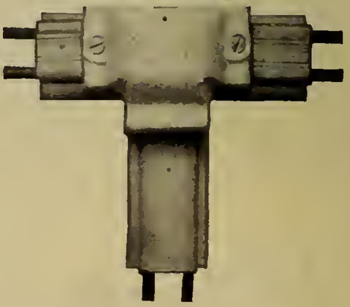

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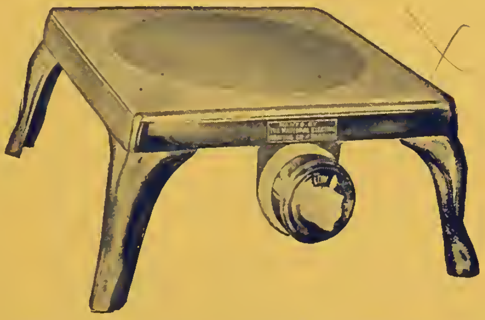

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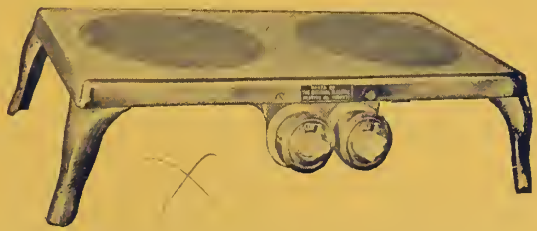

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The National Electric Heating Co., Ltd.
TORONTO - - CANADA

The Economy of Accuracy

A Fuse that does not indicate its condition accurately at all times is an expensive luxury because of the time lost in locating the blown fuse that has not indicated properly.

Time is money and this loss of time means a loss of money and a consequent increase in the cost of your fuse protection.

When you buy an approved enclosed fuse you are paying for a fuse equipped with a reliable indicator, but only on the "ARKLESS" Fuse do you find an indicator absolutely guaranteed to be accurate. Its automatic operation is mechanically correct and all possibilities of its not working have been removed.

"ARKLESS" Fuses equipped with Guaranteed Mechanical Indicators cost no more than the ordinary kind. Specify "ARKLESS" on your fuse orders and profit by the economy of "ARKLESS" Accuracy.

Send today for Catalog 22.

Bentz-Richardson Co., Limited Western Canadian Agents 114 Phoenix Block, Winnipeg, Man.	McNaughton-McKay Electric Co., Limited Eastern Canadian Agents 216 Wyandotte St. East, Windsor, Ont.

Detroit Fuse & Manufacturing Company
1404 Rivard St., DETROIT, MICH.

1/2 Watt "CONDOR" Lamps

(NITROGEN LAMPS)

We are ready to take orders for half watt "Condor" Nitrogen Lamps.

Get our prices.

FANS FANS FANS

Don't let the warm weather catch you unprepared. Order now—TO-DAY for June 1st delivery.

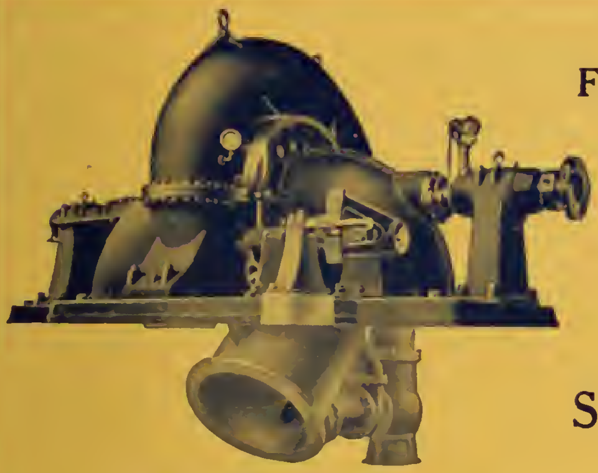
Sole Distributors for Canada

C. H. Basters & Company
TORONTO 22 College Street ONTARIO

Vol. XXIII—No. 11
Toronto, June 1, 1914

Electrical News

Generation, Transmission and Application of Electricity



5250 Horse Power · 275 Feet Head

90% EFFICIENCY

From SMITH HYDRAULIC TURBINES

Recent tests at Holyoke, Mass. of Smith Turbines have again proven their superiority over any turbine now manufactured.

These tests showing efficiencies from **89% to over 90%**.

We design and build turbines for heads from 5 feet to 650 feet.

Send for Bulletin N

S. Morgan Smith Co., York, Pa.

Branch Offices: 176 Federal St., BOSTON, MASS.
614 American Trust Bldg., CHICAGO

FELT GOODS

Washers Packings
Gaskets Strips

And every kind of felt for electrical, mechanical and commercial uses. Please state your requirements and ask for samples and prices.

The Booth Felt Co., Limited
Gananoque, Ont.

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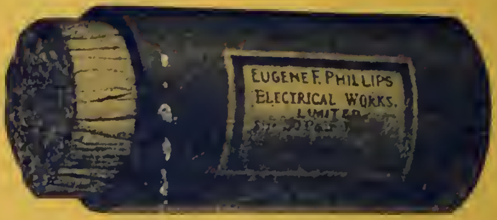
PHILLIPS

Bare and Insulated Copper

WIRES AND CABLES

For Telephone, Telegraph, Lighting,
Power and Street Railway Equipment



Bare and Insulated Electric Wire and Cables for Aerial and Underground use

Railway, Feeder and Trolley Wire

Weatherproof Magnet
and Rubber Covered
Wires and Cables

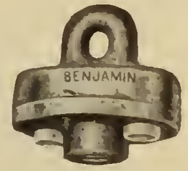
Incandescent and Flexible Cords

Eugene F. Phillips Electrical Works, Limited

MONTREAL - - CANADA

Branches: Halifax, Toronto, Winnipeg,
Vancouver—1144 Homer St.

Cat. No. 6174
Bowl Type



Cat. No 6031
Fitting for Outdoor
Suspension

Cat. No. 6152
Shallow Bowl Type

High Efficiency Units

for

750 and 1000 Watt
Mazda Lamps
Nitrogen Lamps

Properly Ventilated
Correctly Designed
Substantially Built
Best of Copper and
Enamelled Steel Materials

Now Ready for Shipment

Write for bulletin 222

Benjamin Electric Mfg.
Co., of Canada, Limited
TORONTO CANADA

Cat. No. 1012
Indirect Unit

Cat. No. 1015
Indoor Unit

Cat. No. 6156
Indoor or Outdoor Unit

Cat. No. 5549
Angle Reflector

Cat. No. 969
Indoor or Outdoor Unit

Although
they

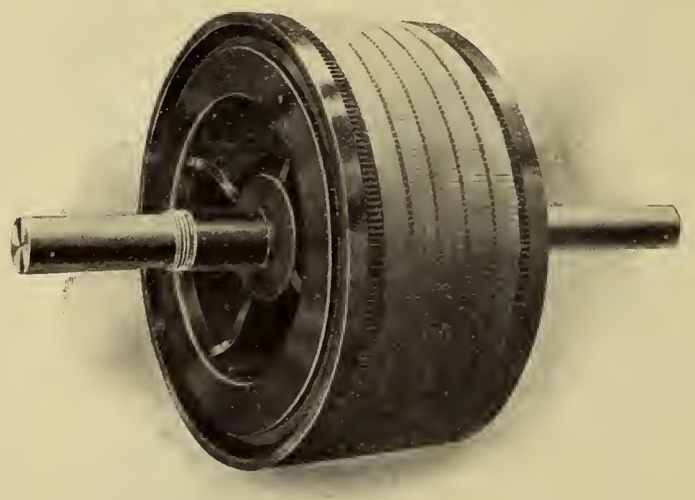
Cost
Less

than others

PEEBLES' MOTORS

are

Worth More!



This cast end-ring alone is an invaluable insurance against the trouble and loss of power caused by screws and rivets working loose.

FERRANTI ELECTRICAL COMPANY OF CANADA
LIMITED

90 Sherbourne St.
TORONTO

Farmer's Advocate Bldg.
WINNIPEG

Railway Condulets

Type BLMC—For Bracket Lamp Outlets. Takes Round Base Fittings.

Type CLOC—For use with Centre Ceiling Fittings.

Type JRR—For use back of Mouldings with rectangular Base Fittings.

Type DSOC—For Deck Sill Outlets. Takes Round Base Fittings.

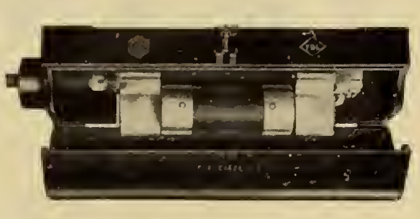
Type MD—Receptacle and Plug for Dynamo-Regular Connection.

Type BRHS—With 100 Ampere Receptacle and Plug. Battery Charging Equipment for car.

Type PJCA—A Medium Size Weatherproof Junction Box.

Type UGC—Arranged as Yard Charging Equipment for Underground Conduit System.

Two-Hub Side Plate for Type RS Condulet.


Type FBL—Weatherproof Housing for 100 to 200 Ampere Battery Fuse.

The Condulets shown here are only a few of the many types designed to simplify and improve conduit installations in railway cars, buildings and yards. Whatever the requirement, we have a Condulet to meet it.

Type RS—Detachable Sides, Weatherproof Junction Box.

You can secure detailed illustrations, descriptions and listings of all Railway Condulets by signing the attached coupon and mailing it to us.

Order Condulets from your dealer. If he does not stock them, write us.

Crouse-Hinds Co. of Canada, Ltd.

Main Office and Works:

Toronto, Ontario, Canada

Kindly send me free copy of Bulletin No. 101

Name..

City..

Province......................................

21113

Packard

MAZDA LAMPS
METERS
TRANSFORMERS

Ask the man who uses them

LARGE STOCKS CARRIED AT

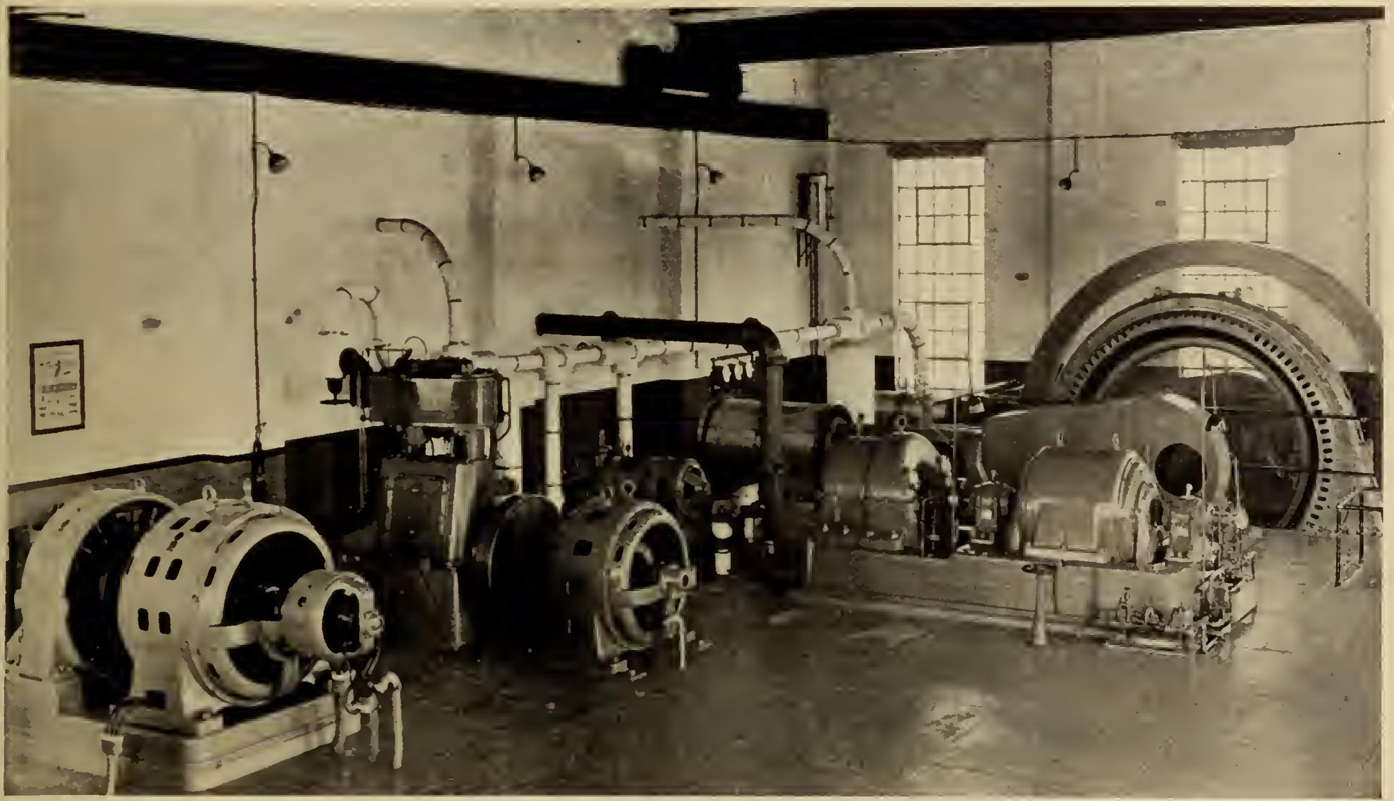
St. Catharines and Winnipeg;
St. John Railway Co., St. John, N.B.;
General Supplies, Limited, Calgary, Alta.;
Rudel-Belnap Machinery Co., Canadian Express Bldg , Montreal, Que.

The Packard Electric Co., Limited

Factory at St. Catharines, Ont.

General Sales Office,
Traders Bank Bldg., TORONTO

N. W. Office and Warerooms,
WINNIPEG



New plant of Sarnia Gas & Electric Company.

The following apparatus was installed by Swedish General Electric, Limited:

1—500 KVA, 3600 RPM, turbo-generator.

1—375 KVA, 100 RPM, engine type generator.

1—190 KVA, 450 RPM, engine type generator.

1—300 KW, 720 RPM, auto-synchronous motor generator set.

1—150 KW, 720 RPM, auto-synchronous motor generator set.

1—Eight panel switchboard.

THE SWEDISH GENERAL ELECTRIC, LIMITED

Head Office—TORONTO

Branch Offices—MONTREAL General Supplies Ltd., CALGARY, Alta.

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The Best Endorsement of the value of the "Electrical News" as an advertising medium is the above List of Advertisers

GALVADUCT

Canada Life Building, Calgary. A "GALVADUCT" Building.

BROWN & VALLANCE, Architects.

L. K. COMSTOCK & CO., Electrical Contractors.

"GALVADUCT"

The most perfect interior construction conduit on the market.

Recognized as the standard of high quality.

Always specify Galvaduct or Loricated conduits

"LORICATED"

A high-class interior construction conduit of the enamelled type, proof against acid or other corrosive agents.

If your jobber cannot supply you—write us

Conduits Company Limited

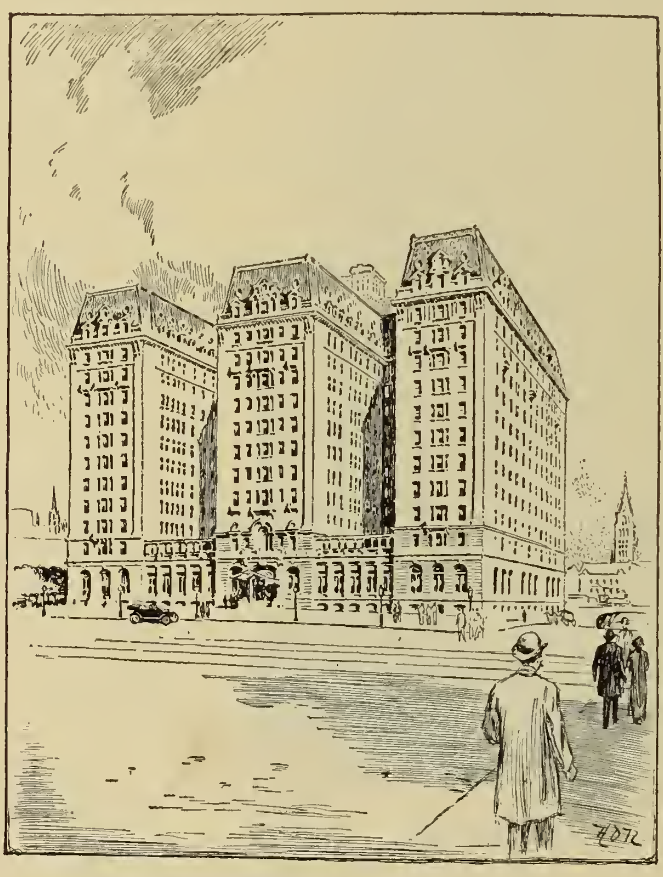
Toronto - - Montreal

LORICATED

Across Canada with the

IMPERIAL WIRE & CABLE CO.

LIMITED



Fifth of a series of advertisements showing buildings of national importance which have been wired with the Imperial Wire & Cable Co.'s, Limited, wires.

This picture shows the C. P. R. Hotel, Calgary

This building was wired with "Adanac" Rubber Insulated Wire

Architects and Engineers - - - E. & W. S. Maxwell, Montreal
Electrical Contractors - Parker-Chase Electrical Construction Company, Calgary

Northern Electric Company

LIMITED

Montreal Halifax Toronto Winnipeg Regina Calgary Edmonton Vancouver Victoria

Successors to IMPERIAL WIRE & CABLE CO., LMITED.

Correspondence previously addressed to Imperial Wire and Cable Co., Limited, at 611 C.P.R. Building., Toronto, and 902 Electric R. Chambers, Winnipeg, should now be addressed to the Northern Electric Company, Limited, Simcoe St., Toronto, and 599 Henry Ave., Winnipeg.

G. M. Gest

Conduit
Engineer & Contractor

503 Power Building, Montreal, Can.

NEWTYPE
BERGMANN
LAMPS
(*Tungsten Filament*)

The Unbreakable Kind

Are Now Ready for Delivery

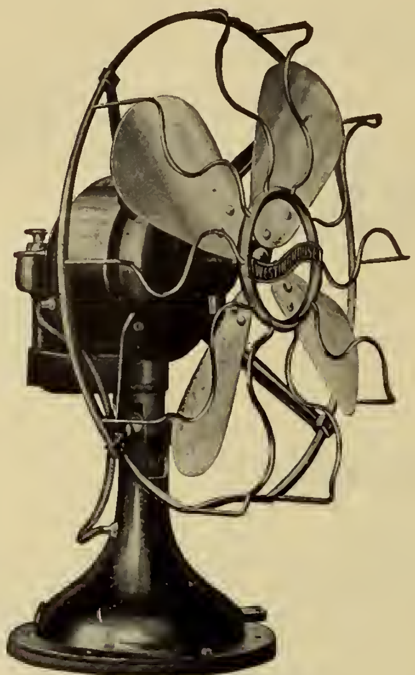
We guarantee delivery to you in good condition

EXCLUSIVE CANADIAN DISTRIBUTORS

P. H. KLEIN Jr. CO.,
LIMITED

23-25 DOWD STREET,
MONTREAL, P.Q.

LIVE AGENTS WANTED ALL OVER CANADA



Mechanical Oscillator

Desk and Bracket

Handle electric fans with entirely drawn-steel frames during the 1914 season.

Northern Electric
Westinghouse
Drawn-Steel Frame Fans

The strength of Northern Electric Westinghouse drawn-steel frames is many times that of cast-steel frames.

The weight of these drawn-steel frame fans is much lighter than that of cast-iron frame fans.

This reduction in weight means a considerable saving in transportation charges and makes these drawn-steel frame fans much easier to handle, an advantage fully appreciated by the ultimate user. Ask about our profitable contract proposition. We assist contract holders with attractive literature, car cards, newspaper copy, cuts. etc. Write our nearest house for catalog.

Northern Electric Company
LIMITED

MONTREAL
HALIFAX
TORONTO

WINNIPEG
REGINA
CALGARY

EDMONTON
VANCOUVER
VICTORIA

Representatives Wanted

Here is a splendid opportunity to handle these tried and tested instruments in your section. For 20 years we've specialized on this class of work and today "Connecticut" instruments are justly famous for their high quality and reasonable prices.

CONNECTICUT

Electric Reset Annunciators
and
Interior Telephones

"Connecticut" Annunciators and "Connecticut" Interior Telephones appeal to the user because they are simple in construction, effective in action, look good, wear well and give lasting service.

Made in a wide variety of styles and sizes—each style suited to its particular requirement. You're selling satisfaction—making lasting customers—when you sell "Connecticut" goods.

Write for Catalog 22C and Full Details

Ask us for particulars of our proposition for representatives. Look over our Catalog and note the completeness, reasonable prices and high quality of the "Connecticut" Line.

Connecticut Telephone & Electric Company, Inc.
Meriden, Conn., U. S. A.

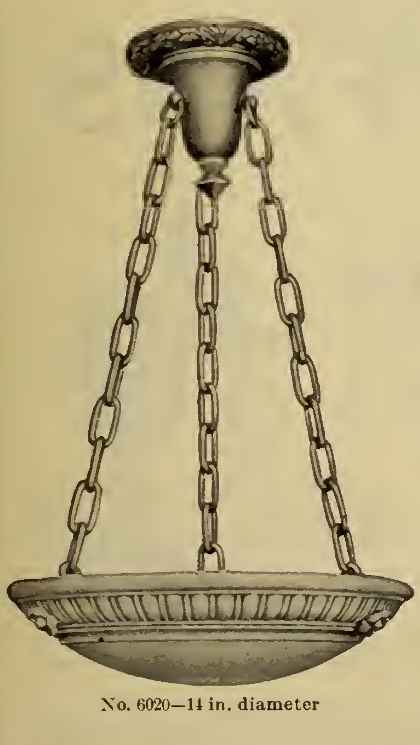
What's in a name ?

"LE CARBONE"
(Made in France)
Carbon Brushes

Means:
Lowest yearly brush **cost.**
Increased car mileage.
Practically no commutator wear.
Armature room **expense reduced.**
Perfect uniformity of efficiency.

Le Carbone Brushes quality never varies!

Rougier Freres Inc.
63 Notre Dame, East
MONTREAL, P.Q.



No. 6020—14 in. diameter

Moonstone Glass

is recommended for the Lighting of

Homes Churches
Stores

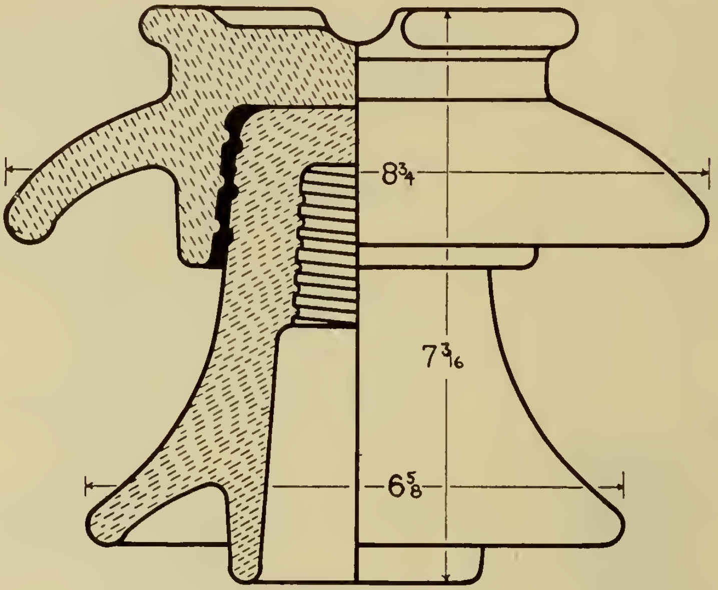
in fact can be used wherever artistic and efficient illumination is wanted.

Write to our Engineering Dept. for Suggestions.

No. 9050—6 in. diameter, 3¼ in. Fitter
No. 9052— 8 in. diameter, 4 in. Fitter
No. 9054—10 in. diameter, 5 in. Fitter
No. 9056—12 in. diameter, 6 in. Fitter
No. 9058—14 in. diameter, 9 in. Fitter

Jefferson Glass Company, Limited
Head Office and Works: Toronto
Branch Sales Offices: Montreal, Winnipeg, Vancouver

CANADIAN INSULATORS

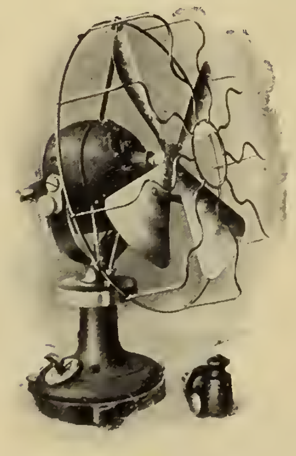


Number	133
Line voltage	30,000
Test voltage	100,000
Rain test	65,000
Leakage distance	17¾-in.
Pin hole	1⅜-in.
Net weight	10½-lbs.
Packed weight	12-lbs.
No. per crate	6

The Canadian Porcelain Company, Limited
HAMILTON, - CANADA

"FORTITER" FANS

Now is the Time



Oscillating Fan

to place your orders for Fans and to display them in your show window.

We can give you prompt shipments and good prices.

Send us your enquiries or ask our representative to call and discuss our unique proposition.

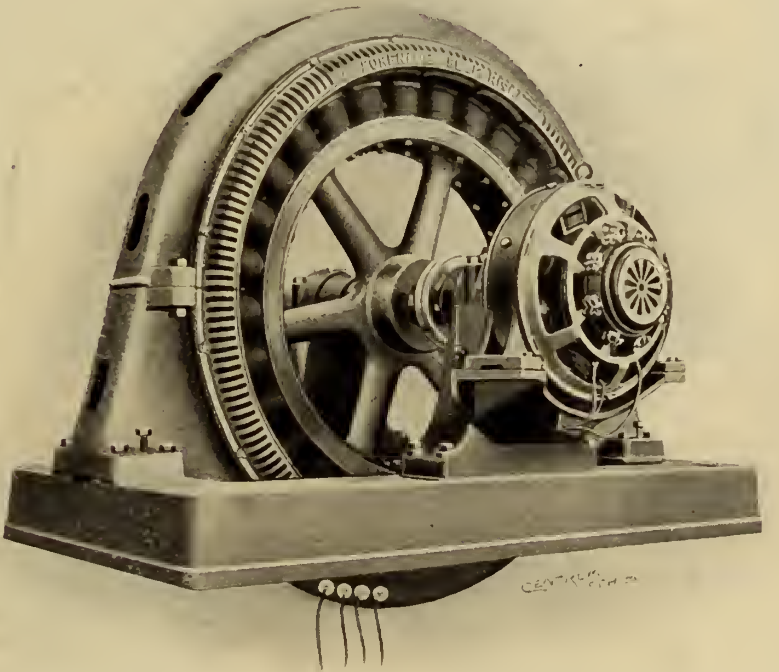
Swivel and Trunion Fan

Canadian Union Electric Company, Limited
Head Office, 130 Wellington Street West, TORONTO, Ont.
Also at, 705 Unity Building, 46 St. Alexander Street, MONTREAL, Que.

Swedish Electrical Machinery

NOTED FOR

Efficiency and Workmanship



Horizontal Water-wheel type alternator with direct connected exciter.

We solicit your specifications for Electrical Equipment

BURNHAM ENGINEERING COMPANY

LIMITED

Canadian Dealers for

The Amalgamated Electric Company of Sweden

Head Office:
Traders Bank Building, Toronto
British Columbia Representatives:
Macdonald, Marpole, Co., Limited
VANCOUVER, B.C.

Montreal Representatives:
Rudel Belnap Machinery Co., Ltd.
Canadian Express Bldg.

Consider the economies which can be introduced by making

Northern-Electric Inter-phones

a vital part of the business organization

Consider an organization with eight department heads. Each of them consumes not less than an average of fifteen minutes per day in trips to other departments. At the rate of $1.00 per hour, this amounts to a loss of $600.00 a year. The average cost of installing a complete eight-station Inter-phone system is approximately $40.00 per station, or $320.00. The fixed annual charges, such as interest, depreciation and maintenance, are about 20 per cent. of the cost, or $64.00 per year. Every year £64.00 spent will save $600.00. Such a net saving of over $500.00 represents more than 1000 per cent. on the original investment. Is there a better producer of economy and efficiency.

Inter-phones are made in three styles—wall, desk and hand set types—to meet every possible condition of service—from two to twenty-four stations

Write for Bulletin

Northern Electric Company
LIMITED

Maker of the Nation's Telephones

MONTREAL HALIFAX TORONTO WINNIPEG REGINA
CALGARY EDMONTON VANCOUVER VICTORIA

PATTERSON BATTERY SETS

For Domestic Work.

WHEN an Electrical Contractor installs batteries nowadays in the old-fashioned way—he's making the biggest mistake possible, for his own interest as well as for his customers! Of course, TO DO A THING RIGHT, usually does cost a little more than to do it wrong, but when with a PATTERSON BATTERY SET, you can obtain such POSITIVE ADVANTAGES, in convenience, positive reliability, long service—life, it is certainly a great mistake to put batteries in in the old way.

For Annunciator Service

PATTERSON BATTERY SETS are designed for the operation of Electric Signal Bells, Annunciators, Fire Alarms, Telephones, Door Openers, Elevator Signals, Program Clocks, Automobiles, Motor Boats—in fact, for all open-circuit work; they cost all the way from $1.80 up, and the best argument for their use is the time-honored slogan: "THEY SAVE MORE THAN THEY COST."

For Automobiles and Motor Boats

We'll gladly forward copy of Catalog describing in detail full line of Patterson Battery Sets. You can't afford to be without a copy in your office!

Northern Electric Company
LIMITED

MONTREAL	WINNIPEG	EDMONTON
HALIFAX	REGINA	VANCOUVER
TORONTO	CALGARY	VICTORIA

EUREKA Vacuum Cleaner

This complete cleaner is something that many of your customers will buy upon demonstration. The Eureka is light and easily operated, it has tools for cleaning everthing in a house and the cost is very reasonable. The motor is made specially for the purpose in our own factory and will last a life-time.

The Eureka has been on the market for over five years and generally conceded to be the best portable electric vacuum cleaner.

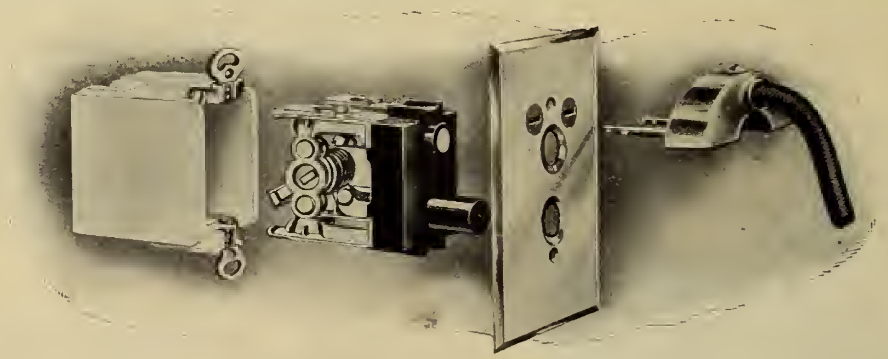
Write for literature and dealers' proposition.

ONWARD MFG. CO.
BERLIN, ONT.

TRADE **METROPOLITAN** MARK
ELECTRIC MFG CO.

Panelboards, Switchboards, Knife Switches, Detachable Mechanism Flush Switches and Receptacles,

One Contact Box, One Face Plate with Renewable, Interchangeable Mechanism and Receptacle Plugs



Metropolitan Detachable Mechanism Combined Switch and Receptacle.

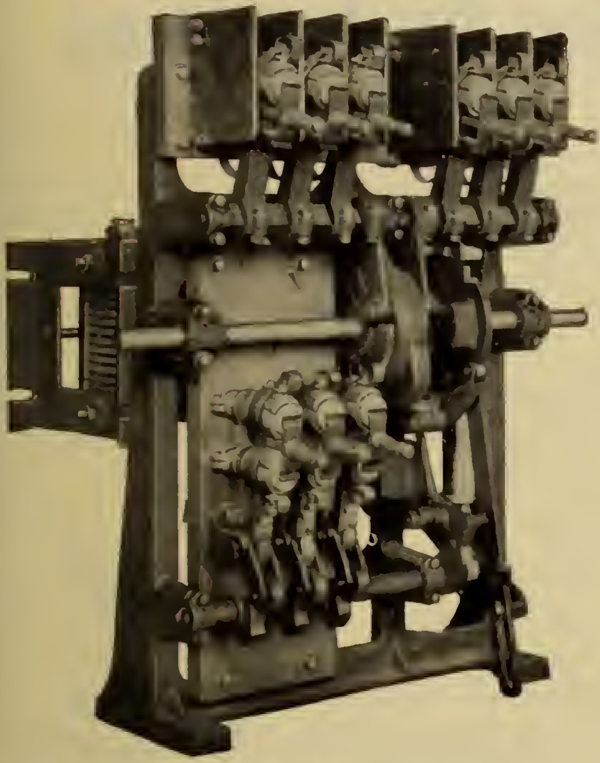
Send us your specifications, our price is right, and delivery the best.

CANADIAN AGENTS:

ECONOMY ELECTRIC CO.

Bank of Hamilton Building **Yonge and Gould Sts., TORONTO**

CUTLER-HAMMER



Full Mechanical Elevator Controller for A.C. Equipments

Cutler-Hammer Elevator Controllers

Made for Every Service

Cutler-Hammer Elevator Controllers are made for elevators of every type, including dumb waiters, freight elevators, slow and high speed passenger elevators, automatic push-button controlled elevators for office building, apartments, etc.

Push-button controlled elevators are coming into considerable use. In some cases this method of operation is employed during the night, while an operator is employed during the day. This allows for 24-hour elevator service, and cuts the cost of operator hire.

The Controller You Need for Your A.C. Elevator Equipments

This new full-mechanical type Controller solves the elevator control problem for the building or plant where only alternating current is available, and where full automatic elevator controllers are not needed.

It is a simple, rugged Controller operated by means of a rope or lever in the car. The operation is not affected by even a wide variation in the voltage of the system which often occurs on A.C. lines.

The Vertical "Butt" Type Contacts Cannot Collect Dust

The surfaces of the "Butt" type switch contacts are vertical, and therefore cannot collect dust or dirt.

The wide range of adjustment of these contacts allows for wear and insures long life.

Safety First

To prevent any chance of trouble, an interlock is provided which prevents the closing of the switches in the secondary circuit of the motor until the primary switches are thrown in.

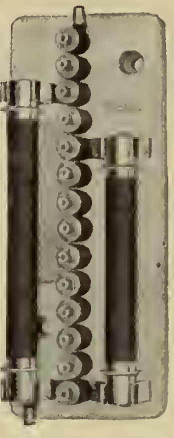
The resistance in the three phases of the motor secondary circuit is cut out in equal steps simultaneously, thus insuring balanced conditions and the best operating results.

Bulletin 9750 describes this new A.C. Elevator Controller. Copy forwarded on request.

THE CUTLER-HAMMER MFG. CO. MILWAUKEE

NEW YORK: 50 Church Street CHICAGO: Peoples Gas Bldg. PITTSBURG: Farmers' Bank Bldg. BOSTON: Columbian Life Bldg.
PHILADELPHIA: 1201 Chestnut Street CLEVELAND: Schofield Building CINCINNATI: Fourth Nat'l Bank Bldg.
PACIFIC COAST AGENT: H. B. Squires Co., 579 Howard St., SAN FRANCISCO, San Fernando Bldg., LOS ANGELES
and Morgan Building, PORTLAND, ORE.

Insure Your Pole Transformers Against Damage by Lightning



Graded Shunt Resistance Multigap Arrester.

C-G-E Graded Shunt Resistance and Compression Chamber Multigap Arresters are the two best policies.

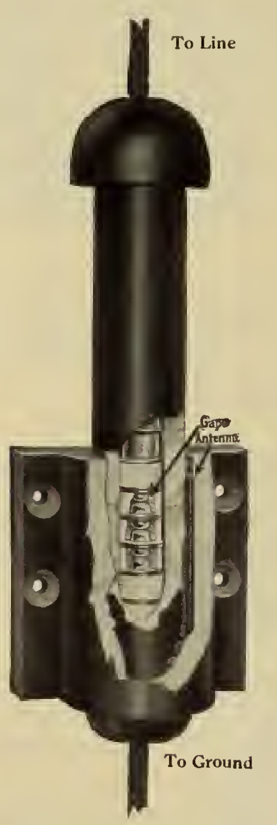
There is no excuse now for failing to protect ***all*** your Transformers.

In C-G-E Multigap Arresters the path to ground lies across a number of small air gaps. The lightning discharge easily passes across the gaps. The generator current which follows is extinguished at the end of the half cycle in which the discharge occurs by the rectifying gases which form in the gaps.

In the graded shunt resistance arrester, the action is assisted by resistances connected in parallel with a number of the gaps. Most of the current shunts through the resistance and the current in the shunted gaps quickly dies out. After this the resistance acts as a series resistance, limiting the current in the ***remaining*** gaps to a value which allows the rectifying gases to quickly stop the flow of generator current.

In the compression chamber arrester great sensitiveness to the lightning discharge is secured by means of the antenna. This also permits the use of a larger number of gaps which, with a low series resistance, ensures thorough extinguishment of the generator current.

There are no moving parts in either of these arresters.



Compression Chamber Multigap Arrester, showing interior parts.

CANADIAN GENERAL ELECTRIC CO.

LIMITED

Manufacturers of Electrical Apparatus and Supplies
for Railway, Light and Power Purposes

Head Office: Toronto. District Sales Offices: Montreal, Halifax, Ottawa, Cobalt, Porcupine, Fort William, Winnipeg, Regina, Saskatoon, Calgary, Edmonton, Nelson, Vancouver, Victoria, Prince Rupert.

Approved by Underwriters' Laboratories

After examination under the provision of the National Electrical Code, the Underwriters' Laboratories approved J-M Fibre Conduit for central station work when laid in concrete.

Style "M" Straight Socket Joint

J-M FIBRE CONDUIT

is impervious to moisture, gases, acids, and all corrosive elements—even stray currents cannot reach the cable protected by it.

The standard ¼-inch thickness of wall indicates an average puncture voltage of 32,600 volts dry and 27,000 volts after 40 hours immersion in water.

Its light weight reduces freight and hauling charges. And the long sections make it easy to lay less jointing and no truing, wrapping or cementing required.

Standard tubes 60 in. long, 2 in. to 4 in. in diameter.

Ask nearest Branch for our Conduit Book. It describes J-M Fibre Conduit fully.

The Canadian H. W. Johns-Manvillle Co., Limited

Manufacturers of Service, Subway and Transformer Boxes; Fuses; Line Material; Insulating Materials; Fibre Conduit; Fireproof Wood; Friction Tape; Dry Batteries; Lighting Systems; Etc.

Toronto Montreal Winnipeg Vancouver

JOHNS-MANVILLE SERVICE COVERS THE CONTINENT

Member of the Society for Electrical Development, Inc. "Do It Electrically" 1855

The Gift that Wears

¶ The month of June brings an increased demand for serviceable and attractive gifts. What is more appreciated than labor-saving electrical household appliances such as Electric Irons, Toasters, Portable Lamps, Vacuum Cleaners? All are simply operated and really useful.

¶ Well assorted stocks at all our branch offices.

Cadillac
Vacuum Cleaner

CANADIAN GENERAL ELECTRIC CO., LIMITED

Head Office: Toronto. District Sales Offices: Montreal Halifax, Ottawa, Cobalt, Porcupine, Fort William, Winnipeg. Regina, Saskatoon, Calgary, Edmonton, Nelson, Vancouver, Victoria, Prince Rupert.

Tallman Fixtures
They're Different

Tallman's
Reputation is in the Goods.

Tallman Brass & Metal Co.
HAMILTON, ONT.

For Satisfying Results in Underground Subway, Power and Light, Telephone and Signal Systems, Park and Ornamental Street Lighting Installations, use

"AMERICAN" Bituminized Fiber Conduit

Long Lengths—5 and 7 feet with socket joints.
Low Cost—two-thirds less than iron pipe, yet it lasts longer.
High Insulation—it withstands a puncture test of 50,000 volts.
Low absorption—guaranteed less than ¾ of 1 per cent.
It may be laid in trench with or without concrete.
Strongest and most durable conduit made—⅜ inch wall, ⅝ inch joints.
Small Sizes a Specialty—1 inch and 1½ inch conduit and fittings.
Electrolysis-proof—water-proof—gas-proof.
Light Weight—Long Joints—Thick Walls.

Compare above specifications with other types before ordering

Interesting and Valuable Booklet "Underground Conduit Construction" free on request. Send for it.

American Conduit Co.
East Chicago, Ind., U. S. A. 140 Nassau St., N. Y. City
Distributors for Canada:
Northern Electric Company
LIMITED
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SAFETY FIRST
The Important Factor in Fare Collection

Satisfaction Guaranteed
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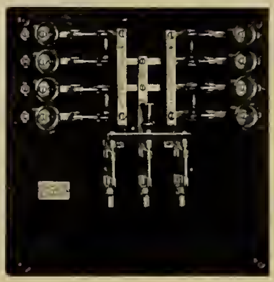
Cleveland Fare Box Co.
5310 St. Clair Ave., Cleveland, Ohio

Trumbull
Panels and Switches



Panel for Plug Fuses

Snap Switch Panel

A complete line of panel boards, cabinets, knife switches, snap switches, cut-outs, rosettes and many other electrical supplies.

ASK YOUR JOBBER SEND FOR CATALOGUE

The Trumbull Electric Mfg. Co.
Plainville, Conn., U. S. A.

Use this sales plan

We finance it — you back it up with personal calls

This is a campaign for window lighting and wiring business, using X-Ray Reflectors. We launched it last month. 250 Contractors, central stations etc., have taken it up so far. Sales have been most gratifying.

This is the plan -- it costs you nothing

You carefully compile a list of names and addresses of the merchants in your locality who need better window lighting. Mail it to us. At our expense, we mail each merchant the three folders at intervals of two days. Each folder has a return card. **This card bears your name** and when the merchant mails it you get the inquiry **direct.**

You wait till the three folders have reached the merchant and then call personally on each. Try and get permission to make a demonstration of X-Ray window lighting in his windows, in a dark room, or in the cellar if need be. Once the merchant sees the "search light" effect he grasps the idea and the sale is easily made.

To assist you, we offer to ship you four Scoop Reflectors and bill them to you **four months from date** with permission to return them if the plan fails.

As you're reading this, make out a list of 25 or 50 names. Give this plan a trial.

Now read about the Results it gets

This is an extract from a letter received from a South Carolina contractor:—

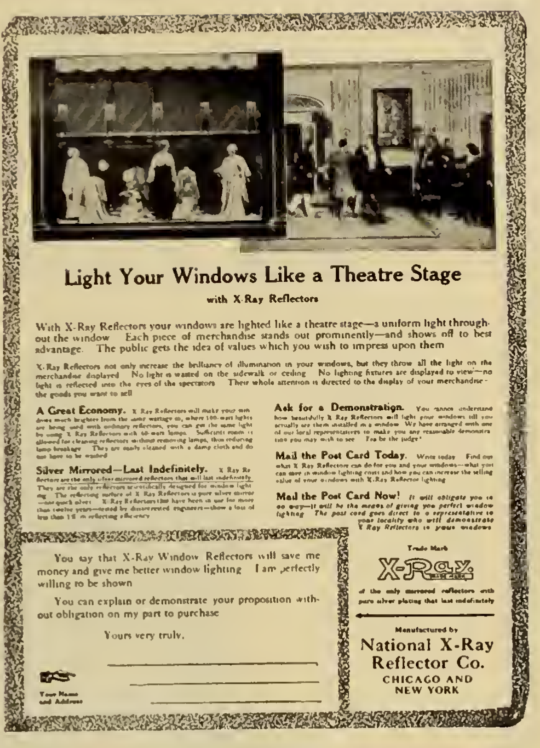
> "We have received the sample reflectors and have made several demonstrations. In nearly every case where we demonstrated these reflectors we got an order, and in the cases where we did not get an order we still have good prospects."

Here's one from LaCrosse:—

> "The circulars you sent out have had effect already," writes a LaCrosse, Wis., contractor, "as the Helfach Jewelry Store called us up this morning and we are going to install the reflectors in their window this afternoon."

What is being done in South Carolina and Wisconsin can ALSO be done in California, Maine and Tennessee,—by YOU.

You can't get business any easier. Send the list in right now,—before you forget it.



Light Your Windows Like a Theatre Stage

with X-Ray Reflectors

With X-Ray Reflectors your windows are lighted like a theatre stage—a uniform light throughout the window. Each piece of merchandise stands out prominently—and shows off to best advantage. The public gets the idea of values which you wish to impress upon them.

X-Ray Reflectors not only increase the brilliancy of illumination in your windows, but they throw all the light on the merchandise displayed. No light is wasted on the sidewalk or ceiling. No lighting fixtures are displayed to view—no light is reflected into the eyes of the spectators. Their whole attention is directed to the display of your merchandise—the goods you want to sell.

A Great Economy.

Silver Mirrored—Last Indefinitely.

Ask for a Demonstration. You cannot understand how beautifully X-Ray Reflectors will light your windows till you actually see them installed in a window. We have arranged with one of our local representatives to make you any reasonable demonstration you may wish to see. You be the judge!

Mail the Post Card Today. Write today. Find out what X-Ray Reflectors can do for you and your windows—what you can save in window lighting costs and how you can increase the selling value of your windows with X-Ray Reflector lighting.

Mail the Post Card Now! *It will obligate you in no way—it will be the means of giving you perfect window lighting. The post card goes direct to a representative in your locality who will demonstrate X-Ray Reflectors in your windows.*

You say that X-Ray Window Reflectors will save me money and give me better window lighting. I am perfectly willing to be shown.

You can explain or demonstrate your proposition without obligation on my part to purchase.

Yours very truly,

Your Name and Address

Trade Mark

X-Ray

of the only mirrored reflectors with pure silver plating that last indefinitely

Manufactured by

National X-Ray Reflector Co.

CHICAGO AND NEW YORK

National X-Ray Reflector Co.

CHICAGO
225 W. Jackson Blvd.

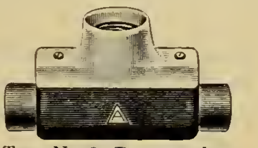
NEW YORK
6 East 39th St.

"UNILETS"

are drawn from steel and possess many merits which are an absolute necessity for up-to-date conduit work. For durability, neatness, space for making wire connections, "Unilets" meet all requirements. "UNILETS" are mechanically right. The conduit is steel, why not the fitting? Try them on your next job. A copy of our new catalogue should be before you. You cannot afford to be without it. Write us at once for your copy.

Cat. No. 9001—Rectangular Unilet.

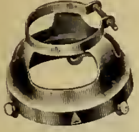
Cat. No. 9002—Rectangular Unilet.



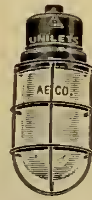
Type No. 2—Rectangular Unilet. Cat. No. 9002 with No. 7650 Receptacle.

Type No. 1 Octagon Unilet. Cat. No. 7501.

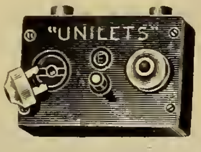
Type No. 4— Round Unilet with enclosed Snap Switch.



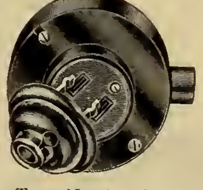
Cat. No. 7322—Shade Holder



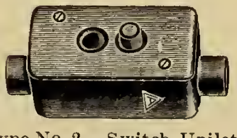
Cat. No. 6906 Vapor-Proof Unilet.



Combination Plug Receptacle and Push Button Switch Unilet—Hubbell Plug Receptacle and Arrow E Push Button Switch Attached.



Type No. 1—4-inch Round Unilet with Two-phase Receptacle Attached.



Type No. 2 – Switch Unilet. Cat. No. 6501. with Push Button Switch Attached.

ADDRESS DEPT. "D" FOR COPY OF CATALOGUE No. 7

APPLETON ELECTRIC COMPANY

Main Office and Factory CHICAGO 212-214 N. Jefferson Street

For Sale in Canada by

The Mainer Electric Co., Ltd., Winnipeg **Marshall-Wells Co., Ltd., Winnipeg** **Chapman & Walker Ltd., Toronto**

Sorry, People

But

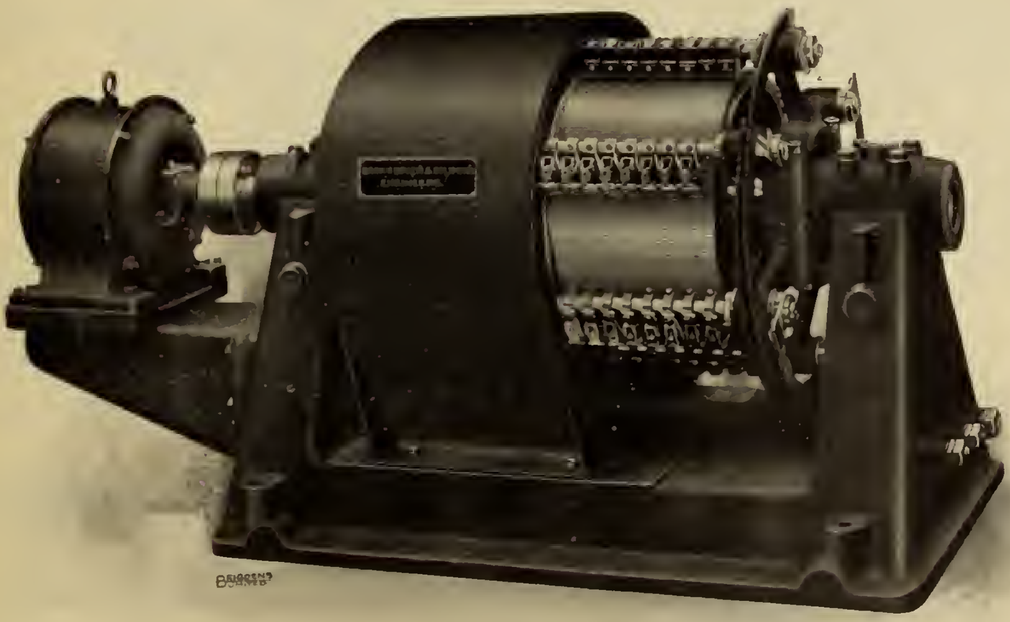
WE just couldn't get our electros out in time to give you the "dope" on that new line of ours which we mentioned in our last ad. However, here's a hint :—The article is a brand new design in Tumbler Switches,—one that will instantly jump to first place. Honestly, People, it will be a winner and we hope to show it to you in our next ad —July 1st.

Watch for it!!

The Duncan Electrical Company
Limited
MONTREAL

Makers of "Duncan Quality" Electrical Supplies

The Brown Boveri Phase Advancer



Phase Advancer for use with Induction Motors

The **EARNING CAPACITY** of a **POWER STATION** is reduced by a low power factor, which loads up the generators with wattless current and cuts down the saleable output.

If you have large, slow speed, low power factor induction motors on your system, Brown Boveri Phase Advancers will raise the power factor and increase the saleable output possible from the generating plant.

There are other advantages as well.

Write for particulars to

THE CANADIAN
CROCKER-WHEELER CO.
LIMITED
MANUFACTURERS AND ELECTRICAL ENGINEERS

Head Office and Works
ST. CATHARINES

District Offices
MONTREAL, TORONTO, VANCOUVER

CANADA WIRE & CABLE CO. LIMITED
CANADA
TORONTO CANADA

A chain is no stronger than its weakest link—and

a transmission system is no more efficient than the weakest spot in the line.

The superior quality of raw material and our extreme vigilance during the course of manufacture are responsible for the reputation we have gained in the marketing of electrical wires and cables.

Get our quotations on

- WEATHER PROOF COPPER and ALUMINUM Line Wire.
- WEATHER PROOF COPPER CLAD Wire for series arc lighting.
- RUBBER COVERED WIRES and CABLES.
- RAILWAY and POWER FEEDER CABLES in COPPER and ALUMINUM.
- COPPER TROLLEY WIRE.
- COPPER CLAD WIRE (Duplex Metals).
- GALVANIZED STEEL STRAND GUY WIRE.

Prompt shipments made from stocks carried at Toronto, Montreal Winnipeg and Vancouver.

Canada Wire & Cable Co.
Limited

TORONTO **1160-1170 Dundas Street** **ONTARIO**

Sales Offices:

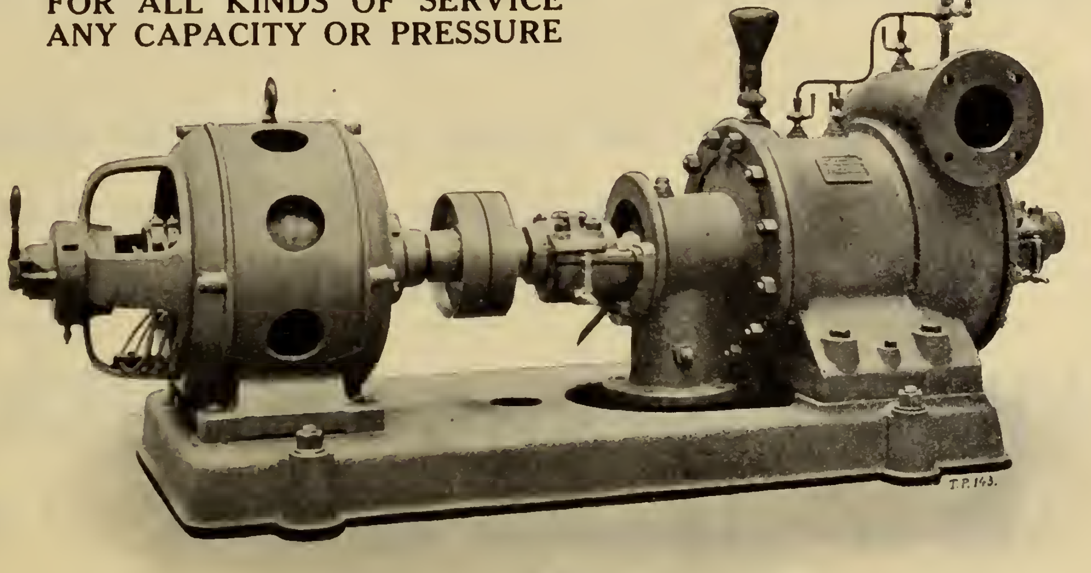
401 Lake of the Woods Bldg.
Montreal, Que.

A. E. Esling, 150 Princess St.
Winnipeg, Man.

Macdonald, Marpole Co., Ltd., 427 Seymour St., Vancouver, B. C.

TURBO-PUMPS

FOR ALL KINDS OF SERVICE
ANY CAPACITY OR PRESSURE



Highest Efficiency

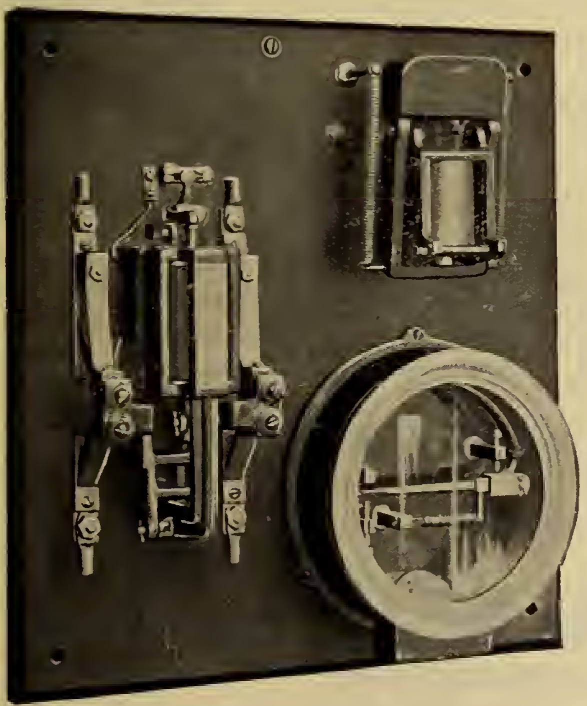
Greatest Reliability

ESCHER WYSS & CO.

Head Office For Canada:
626-627 Coristine Bldg., Montreal, Que.

Agent for Western Canada: Mr. C. L. Trimingham, 206 Nanton Building, Winnipeg, Man.

SUNDH PRESSURE REGULATORS



For use in starting A. C. and small D. C. Motors.

Specially designed for installations where they can be thrown across the line without the use of starting resistance. Compact and reliable and will not get out of order.

When the amperes taken by motor exceed the 10 amp. capacity of the magnet switch, a switch of large capacity is added, the magnet switch acting as a relay.

We manufacture a complete line of controlling devices, such as Motor Starters, Pressure Regulators, Tank and Sump Switches, Panels, etc.

Send for Catalogue.

Sundh Electric Company - - New York, U.S.A.

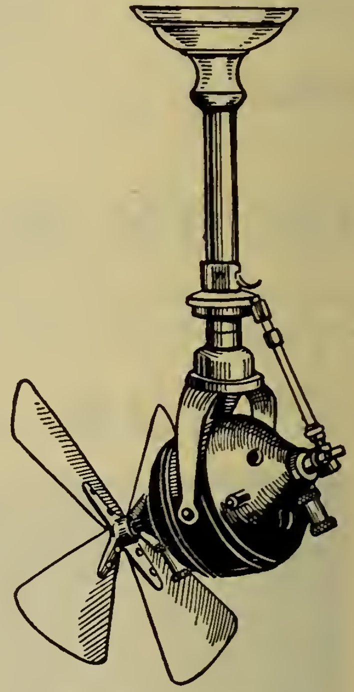
Chapman & Walker Dealer Talks

This time we want to impress upon you the advantages of placing your orders *early* in preparation for the

APPROACHING FAN SEASON

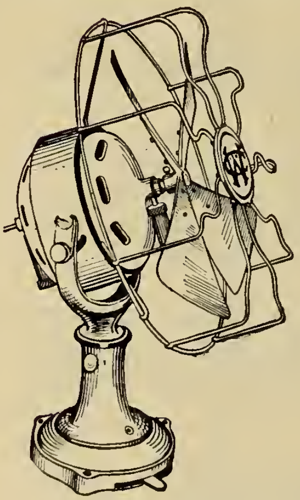
Avoid the troubles you had last season

Don't take chances this year in having your fan orders delayed and then coming along to you when the season is half over. Make sure of your order **early**—make sure of it **right now.** Send in for our **"Special Future Delivery"** contract form. It insures the delivery of your fan order in plenty of time for the beginning of the fan season.



Self Rotating Ceiling Fan

The MARK **of QUALITY**



Oscillating Desk Fan.

We have many different styles and sizes to choose from, consisting of oscillating and stationary desk, wall and ceiling types. This year we are quoting special low prices for direct import orders.

Send us your inquiries early and make sure of early and prompt delivery.

Ask for a copy of our illustrated catalog

CHAPMAN & WALKER, Limited

118-120 Richmond St. W., TORONTO, ONT.
VANCOUVER MONTREAL
WINNIPEG—C. L. Trimingham, 206 Nanton Bldg.

Progressive

is the word that characterizes the Wagner Company, because of its large number of new and important contributions to the art of alternating current motor building.

One of particular importance is the

Self-Starting Polyphase Motors

popularly named

'The Public Servant'

Wagner, Quality

THE
STERLING MARK
IN THE
ELECTRICAL
WORLD

because of its simplicity of control and its reliability.

The Motor is Started by Simply Closing the Switch

and has sufficient torque to start under full load, without abnormally heavy current demands. Its running characteristics are those of the usual wound rotor type motor.

The use of this motor solves remote control problems. The motor may be at a considerable distance from the starting switch.

If the line voltage fails the motor automatically returns to the starting position so that it automatically starts when line voltage is re-established.

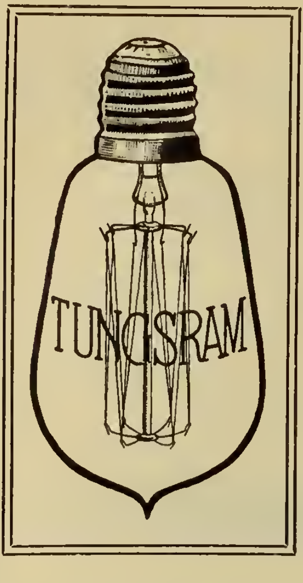
Think of the complicated devices necessary with ordinary motors to affect the same service.

Bulletin 954 Gives Details

Wagner Electric Manufacturing Company
of Canada Limited-Montreal

27 Guardian Bldg., Montreal **1222 Traders' Bank Bldg., Toronto**

Member of the Society for Electrical Development—Do It Electrically.



"TUNGSRAM"

THE

strongest filament

PERFECT

satisfaction to consumers

LAMPS

for all Lighting purposes.

All Sizes and Voltages carried in stock at Montreal.
Also for import.

Ontario Selling Agent

WALTER H. WARRINGTON
406 Tyrrell Building
Main 2466 TORONTO
Representing
The Perkins Electric Company Limited, Montreal, P.Q.
Brandt-Dent Company, Watertown, Wis.
Crown Novelty Company, Chicago, Ill.
Flexible Conduit Company, Guelph, Ont.

Code Signaling in Factories

The quickest and best way to locate a foreman or superintendent in a noisy mill or factory is by the use of an effective code signaling system.

The Reacto Factory Horn

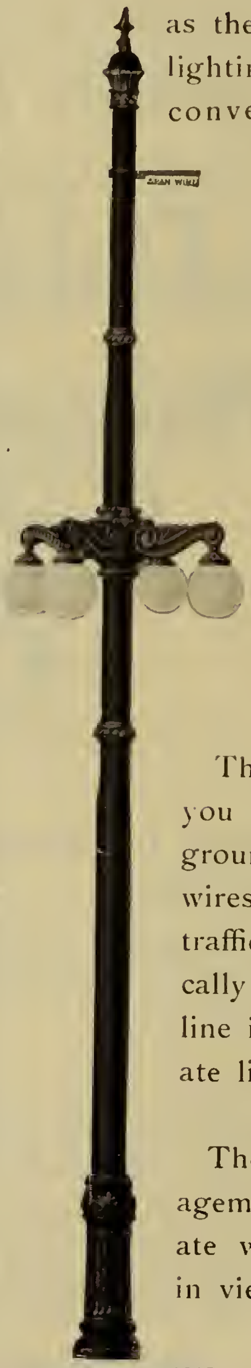
forms the basis of a most effective system for this purpose and operates on the commercial power circuits. either direct or alternating.

More efficient and dependable than any bell or other device.

Get acquainted with it now—Bulletin 1787 N.

The Holtzer-Cabot Electric Co.
BROOKLINE, MASS.
6161-65 So. State St. CHICAGO
101 Park Avenue NEW YORK
1003 Union Trust Bldg. BALTIMORE

Use the Railway's Trolley Poles



as the basis of your new street lighting system. You can easily convert them into attractive Mazda Lamp Standards or arc lamp supports by use of

ERECO Combination Railway Lighting Pole Fixtures

This system, besides saving you the expense of underground construction, gets the wires up out of the way of traffic, where they are practically unnoticeable and the curb line is not crowded with separate lighting standards.

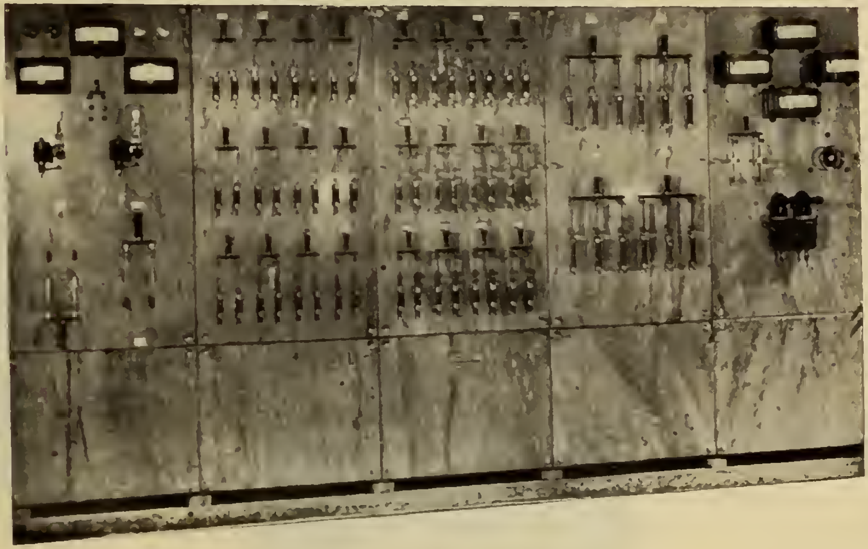
The progressive railway management will gladly co-operate with you with this object in view.

Design No. 10015

Electric Railway Equipment Co.
Cincinnati, Ohio
Designers Manufacturers
Canadian Representatives:
Dawson & Co., Limited, Montreal, Winnipeg
N. Y. Office, 30 Church St., Hudson Terminal Bldg.

"DEVOE" MEANS QUALITY

Panels, Switches, Switch-Boards built to any specification



An examination of "DEVOE" Standard Panels, Switches and Switchboards will convince you they are the best made.

We specialize in Switch Boards.

THE DEVOE ELECTRIC SWITCH COMPANY

Office and Factory 157 Craig Street West, Montreal, Que.

Frank G. Scofield, Ontario Sales Representative, Lumsden Building, Toronto, Ontario

---

Safety Key Switch Type

SAFETY FIRST

The New Key Switch Type

KRANTZ PANEL

is absolutely dead face—has no exposed live contacts

The Safety Cover is made of enameled steel, flush with the lower side of Door in trim. Combination on and off indicator and card holder it ozidized.

Standard and special designs for all requirements.

Our engineers are at your service.

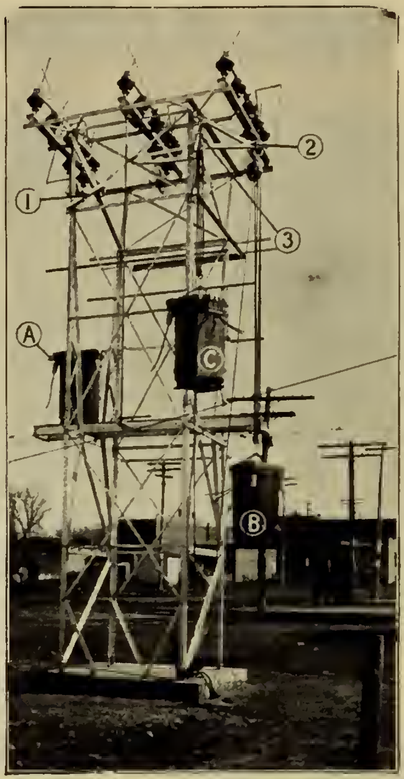
May we send you our Bulletins ?

THE CANADIAN KRANTZ ELEC. & MFG. CO., LTD.

67-71 Adelaide St. West

TORONTO, ONT.

Moloney High Tension Transformer



Moloney High Tension Transformer

Handling Transformers on Steel Tower Sub-Stations

The latest development in outdoor stations to meet conditions as encountered in commercial practice is shown in the above illustration—the switching and protective units being of the standard Type "CRE" form with Moloney Transformers. The method of handling transformers is, however, unique, effective and low in cost.

This station is equipped with a transformer platform provided with a transfer truck, which can travel the full length of the I-beam supports. Near the top of the front corner posts are pivoted single and double jib cranes indicated as 1-2-3. These jib cranes which have a large radius of action are provided with steel U-bolts to take the tackle hooks. The method of handling transformers is well shown in the accompanying illustration.

Assuming that the middle transformer "B" has failed and must be removed, the end transformer "C" is first raised by means of the No. 3 jib crane, swung around out of the way and left hanging on the tackle. The transfer truck with the middle transformer "B" is next rolled to the end of the platform, the transformer being raised with jib No. 2, swung around and lowered to the ground.

To restore service, transformer "C" is swung around and lowered to the platform, the station now operating in open Delta until the defective transformer can be repaired. By this combination of transfer truck and jib cranes transformers of any capacity up to 4,000 lbs. can be handled at a minimum expenditure of time.

The particular illustration shown is known as Type "SD," has been started with three 30-KW., 22000 volt, 25 cycle Moloney Type HE transformers and when the load increases sufficiently three 50-KW. capacities will be used.

Moloney Electric Company of Canada

Limited

WINDSOR, ONTARIO

Factories at Windsor, Ont. and St. Louis, Mo., U. S. A.
Branch Offices: Montreal, Toronto, Winnipeg, Vancouver.

SPECIALISING—

—IS THE KEY TO EFFICIENCY; THE MAN WHO DOES TWO THINGS WELL CAN DO ONE THING BETTER. WE ARE SPECIALISTS IN ALUMINIUM FOR ELECTRICAL WORK —CABLE, WIRE, BUS BARS—ALL THESE ARE DESIGNED AND FIGURED OUT BY OUR OWN EXPERTS. SPECIALISTS ALL, AND AT YOUR SERVICE.

THE BRITISH ALUMINIUM CO., LIMITED
(of London, England)
60 W. FRONT ST., TORONTO

FANS

A
N
S

The Last Call for June Delivery

We have just received a large import shipment of desk, bracket, oscillating and exhaust fans from which we are now filling orders.

(We also wish to impress upon the trade that we carry a complete line of separate parts for repairs.)

If you have not already placed your order get our prices and discounts for June delivery.

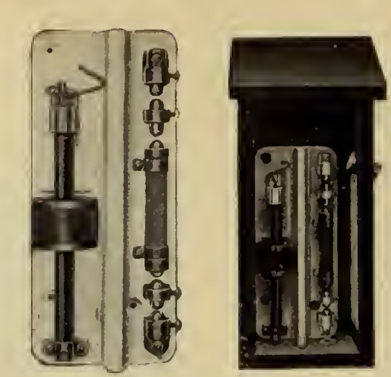
Sole Canadian distributors for

"CONDOR" LAMPS

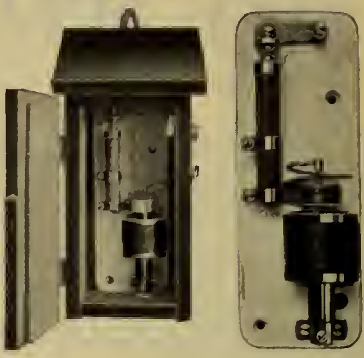
C. H. Basters & Company

22 College St. :: TORONTO

You Must Use These Lightning Arresters


Arresters for A. C. Service 1200 to 2500 volts.

Arresters for A. C. Service 2500 to 3500 volts.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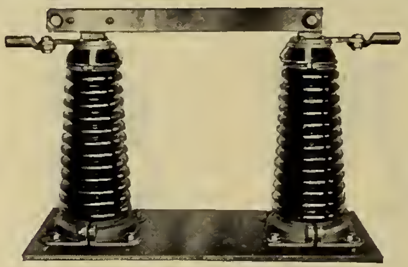

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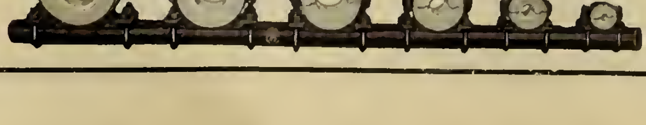

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Exit Toronto's "Expert"

The "scathing denunciation" by Chairman McIntyre of the Ontario Railway & Municipal Board of one of the so-called "experts" in the recent valuation of the Toronto Railway System places one more obstacle in the way of an agreement between the company and the city. Now, more than ever, the electors will find it difficult to form any satisfactory judgment regarding the real value of the property, as the Board's finding implies both dishonesty and incompetence.

It has, of course, all along been an entire mystery to the engineering profession why a person with neither technical knowledge nor practical experience in such matters should have been named by a responsible body like the Toronto Board of Trade to represent the city's interests in so important a valuation. The natural conclusion was that this appointee possessed other qualifications in a superlative degree, and not obtainable in an engineer, which specially fitted him for the task. Chairman McIntyre has, however, failed to unearth any qualifications that will tend to increase the confidence of the citizens of Toronto in the recent railway valuation, in so far, that is, as it was prepared by the local "expert." It should not now hurt the feelings of the Board of Trade, City Council or whatever body was chiefly responsible for this appointment to suggest that they acted entirely without judgment. We will go so far as to suggest that if the value of the local street railway system is required there are many engineers—in Toronto—who can determine it. The Engineers' Club, for example, has a membership of approximately 500, including engineers as capable probably, as any on the continent, and the poorest of which at least would do the city no discredit. We are of the opinion that an inquiry at these technical quarters would have resulted in the selection of a man and the preparation of a report in which the council and electors could have placed confidence. Having the financial interests and the moral reputation of the city at heart we earnestly commend this policy in future where technical information is required. In the present instance we think it only just to Canadian "engineers," to state that the reference in Chairman McIntyre's report does not apply to one of their profession—a profession, we have good reason to believe, in which honor is an outstanding characteristic.

Insulation Resistance and Moisture

A valuable paper was recently presented by Mr. S. Evershed before the Institution of Electrical Engineers on the subject of "The Characteristics of Insulation Resistance." Mr. Evershed's paper is the result of some three years of experimental work, and though, as the author points out, this work is far from complete, enough has been done to form a basis for future work. Three phenomena considered by the author are the effect of moisture, of voltage and of polarity. Inasmuch as the experiments have not yet been completed the paper deals chiefly with the first of these, the effect of moisture. The difference between the applied potential difference and the insulation from resistance has been traced by the author, in a curve, from a few volts up to the break down point. This curve consists in general of two parts of opposite curvature connected by a more or less straight line, the length of which varies with the nature and condition of the insulator. The first part of the curve, the author finds, is determined by the extent to which leakage is due to moisture. The author's experiments show that the leakage through the insulator for this part of the curve is practically negligible and that for all practical purposes the insulator may be regarded as having no inherent conductivity, the conductive power which it appears to possess being caused by leakage due to moisture either on the surface or absorbed in the interior. Throughout the experiments the presence of moisture is shown to be a determining factor which regulates the breaking point. This factor is given as explaining why there is so much discrepancy between break down tests in the factory and in actual operation. The author states that his experiments indicate that the only place where this discrepancy is not shown is with non-absorbent dielectrics. Brief extracts from Mr. Evershed's paper are printed elsewhere in this issue.

The Nova Scotia Tramways and Power Company

The bill incorporating the Nova Scotia Tramways & Power Company, Limited, has been passed by the local legislature with a number of amendments to the original bill designed to safeguard the interests particularly of the citizens of Halifax. As the bill stands the capital of the company is $6,000,000 and in addition to absorbing the Halifax Tramways Company, with its obligations and franchise rights the new company may also acquire the power sites and rights on the Gaspereaux River owned by the Nova Scotia Light & Power Company. The new company undertakes to commence actual work in the development of one of their water power sites within two years from the date of the passing of the Act and to expend not less than half a million dollars in another two years. It is also agreed that the yearly payment to the City of Halifax shall never be less than that paid in 1913 by the Halifax Tramways Company and that the rates for light and power shall never be increased above those paid at the present time; also the fares now charged on the local railway shall not be increased and in addition workmen's tickets at a price of 8 for 25c shall be sold in future. Points at issue shall be referred to the Public Utilities Commission.

An Electric Farm Installation

Mr. C. E. Locke, Edgeway Road, near St. Thomas, is one of a number of farmers who are taking advantage of the ample supply of electric energy in that district, and has had his farm buildings and residence equipped throughout with light and power. Mr. Locke has contracted for 2 h.p. on a flat rate from the lines of the Hydro-electric System and is receiving his power from the commission at 110 volts, 3-phase, 25-cycles.

The residence is wired throughout with the average run of fixtures in each room. Provision is also made for an electric grate in the parlor and an electric heater in the bathroom. It is also the intention to make use of a number of the modern household appliances such as irons, toasters, vacuum cleaners, etc. The house is of very commodious dimensions being the old typical farm-house, brick construction.

Mr. Locke pays particular attention to his dairy department and will use considerable electric energy both for light and power in this connection. The milking room, cooling room, driving shed, stable and work shop have been lighted throughout with tungsten lamps. The farmyard and driveway, as also of course the house, will be lighted with tungstens.

In the barn he has also supplied a 2 h.p. Crocker-Wheeler motor, 110 volts, 25-cycle, 3-phase which he uses for running the chopper, grinder, milking machine, turnip pulper, etc.

There is also installed an electric water heater of Hot Point variety for heating water in the milking room for cleaning the milking cans. The advantage of this heater is that it can be left in operation during the night when all other power is off and in this way it does not increase the peak load on the lines.

Pleasure Resort at Deep Bay

In connection with the operation of its Saanich interurban line, opened for service last year, the British Columbia Electric Railway is planning for the development of a pleasure resort on Vancouver Island to meet the demands of residents and visitors to Victoria, the capital of British Columbia. The line passes for 22 miles through a country which is magnificent from the landscape point of view and which will probably ultimately become the location of many large suburban country estates.

The initial work of the company in the line noted is being carried out at Deep Cove, the northern terminus of the line. The place is naturally suited admirably for the demands of the pleasure seeker or picnic party, providing the attraction of groves on the one hand and excellent bathing beaches on the other. It is located only a run of a little over an hour from Victoria and with the frequent train service given will probably be a popular resort.

To meet the immediate demands the company is now building at the terminus a tea room and refreshment booth which will also meet the demands of a small number of permanent guests. The building is 50 by 56 feet in size and two storeys in height. It is of frame construction and of ornamental design, the lower storey being weatherboarded and the upper storey shingled. The ground floor is divided into rest rooms for ladies, large tea room, refreshment counters, toilets, etc. The two sides of the building facing the Saanich Gulf are surrounded by wide varandas. The upper floor is divided for apartments for the caretaker and several guest rooms.

The company contemplate the construction of another wing of similar type and the joining of the wings so as to form a summer hotel, 102 by 56 feet in dimensions and providing for the demands of a large number of summer guests. This work will probably be carried out next year.

In the Saanich Gulf and within easy reach of Deep Cove are a large number of small islands, all of which are partially settled. It is probable that a daily launch service will be arranged during the summer, connecting with the interurban trains, thus combining the pleasure of an interurban run and launch ride outing.

European Telephone Systems

In his recent work "The public ownership of Telephones on the Continent of Europe" the author Dr. A. N. Holcombe, does not favor competition and writes as follows regarding public ownership,—"In the telephone business, competition is a failure. Considered as an automatic arrangement for maintaining an accurate adjustment of the supply of telephone facilities to the demand, it easily gets out of order. So long as it remains in order, its effect is to diminish the utility of the service to render which telephone facilities are created. For a while it is capable of bringing about low rates and stimulating a rapid development. Sooner or later, however, the self-interest of the competitors or the disillusionment of the public authorities will cause the termination of competition and the substitution of a regime of monopoly. This has been the result everywhere in Europe where competition has once existed, except in Stockholm, and in Stockholm the bankruptcy of the private company or the purchase of its business by the government is only a matter of time. Competition as a permanent status in the telephone business is neither desirable nor possible." A review of success in Germany and Switzerland, and failure in France, leads Dr. Holcombe to the conclusion: "For under the actual alternative to public ownership in such an industry, namely, a well-regulated private monopoly, there is no greater security for sound industrial progress than under public ownership, and it is certain that at least a portion of the advantages of industrial progress will be appropriated by the monopolist, solely by virtue of the fact that he is a monopolist. The great merit of public ownership, therefore, as an agent of production, is that under the proper industrial conditions it fulfils, more economically than any other method of industrial organization, the direct purpose of production,—that is, the supply of the consumer with the kind and quantity of goods that he desires."

Vaudreuil Electric Company

The Vaudreuil Electric Company, Limited, organized under a Dominion charter to distribute power generated by the Cedars Rapids Manufacturing & Power Company (of which it is a subsidiary) are constructing a 12,000 volt, two circuit pole transmission line from Cedars to Vaudreuil, P.Q., a distance of six miles. The chief object in the organization of the company is to create an industrial development in the vicinity of Vaudreuil, where cheap electrical power in great quantities, low-priced manufacturing lands adjacent to the main lines of the C. P. and G. T. Railways, and Ottawa River water transportation, all near Montreal, would seem to offer inducements for the location of manufacturing industries. This company are also building 2,200 volt mains, street-series and 110 volt secondaries in Dorion and Vaudreuil villages, including a 12,000 cable crossing Soluanges Canal with the necessary sub-stations. The company expect to furnish street, residential and commercial lighting and power in Vaudreuil and Dorion villages by July 1 next and will extend their lines to Cedars Village, Hudson, Como, and Hudson Heights. The line will also be further extended to Ottawa and St. Lawrence river points as required. Power is at present being purchased from the Provincial plant of the Montreal Light, Heat & Power Company, and supplied over the four-mile 2,200 volt line to manufacturers at Cascades, Que., until the Cedars plant will be in operation on January 1, 1915.

The officers of the company are: President, Howard Murray (vice-president Cedars Rapids Manufacturing & Power Company, and vice-president Shawinigan Water & Power Company); secretary-treasurer, James Wilson (secretary of the Shawinigan Water & Power Company); manager, S. H. Brownlee, (late of Cedars Rapids Manufacturing & Power Company, and Ontario Power Company, Niagara Falls). The contract for the construction of the transmission line has been let to Mr. S. W. Hamilton, Coristine Building, Montreal.

An Inspection Engineering Company

The recent formation of an "Inspection" company is practically a new development in the Canadian electrical field and is of special interest to engineers and purchasers of electrical apparatus. The new company will be known as the Allen Inspection Company and will have head offices at 306 Kent Building, Toronto. This company will specialize in inspection during manufacture, and make tests and reports on electric power apparatus, insulators, steel towers, transmission line hardware, wires and cables, conduit, etc. Resident inspectors will be located at important manufacturing centres, and the company is prepared to look after contracts for consulting engineers, operating companies, municipalities, governments, manufacturing companies and others requiring specialists for this class of inspection work.

The manager of the company is Mr. A. D. Allen, who has had a broad experience in this class of work. Before entering McGill University, Mr. Allen had several years' practical experience in the shops of large electrical manufacturing companies in the United States and later was engaged on construction work in the Niagara district. Since graduation he has acted as inspector for the Shawinigan Water and Power Company on the equipment required for their new 75,000 kv.a. generating station and 100,000 volt transmission system. In addition he has looked after inspection work for various consulting engineers on a number of important power developments installed in different parts of Canada during the last three years.

New Rates in Moose Jaw

The city of Moose Jaw have rearranged their schedule of light and power rates and the following will be effective July 1, 1914.

Lighting—With one meter—for all current used by one installation and through one meter, 7c per kw.h. meter rental 25c per month; minimum charge 75c per month.

Commercial or Domestic Lighting, Heating, Cooking or Small Motors on lighting circuit—(with two rate meter)—For all current used between 4.30 p.m. and 11.00 p.m. from September 1 to March 31 and between 7 p.m. and 11.00 p.m from April 1 to August 31, 7c per kw.h. For all current used between 11.00 p.m. and 4.30 p.m. from September 1 to March 31 and between 11.00 p.m. and 7.00 p.m. from April 1 to August 31, 3c per kw.h. Minimum charge $3.00 per month; meter rental 25c per month.

Power—A fixed charge of $1.00 per h.p. per month of maximum demand or connected load is charged with an added meter rate depending on the amount of the consumption. The meter rate up to 3 h.p. is 3.5c per kw.h.; from 4 to 10 h.p., 3c per kw.h.; from 11 to 25 h.p., 2.5c; from 26 to 50, 2c; from 51 to 100, 1.5c; all over 100 1.25c. Discounts vary according to the class to which the customer belongs, there being four classes, A, B, C and D, very similar to the schedule of the Hydro-electric Power Commission of Ontario.

International Engineering Congress

Among the general subjects to be treated before the International Engineering Congress which meets in San Francisco, September 20-25, 1915, one of the broadest is that of "Materials in Engineering Construction" a subject of interest in all phases of engineering activity. The list of topics is very complete and includes among others the following:—(a) "The place of Copper in the Engineering Field"; (b) "Alloys and their use in Engineering Construction"; (c) "Aluminium in Engineering Construction." Other topics are:—"Timber"; "Preservative Treatment of Timber"; "Substitutes for Timber in Engineering Construction"; "Brick in Engineering Structures;" "Clay Products in Engineering Structures;" "Probable and Presumptive Life of Concrete Structures made from Modern Cements;" "Aggregates for Concrete;" "Slag Cement;" "Waterproof Concrete;" "Cements containing Additions of Finely Ground Foreign Material;" "Economics of the World's Supply of Iron;" "The Life of Iron and Steel Structures;" "The Employment of Special Steel in Engineering Construction."

Convention of Electric Vehicle Interests

By far the most successful convention of the New England Electric Vehicle interests, conducted jointly by the Electric Motor Car Club of Boston, and the New England section of the Electric Vehicle Association of America, was held Tuesday and Wednesday, May 19 and 20, in the Engineers' Club, Boston, Mass.

The papers presented were: "Co-operation," by W. H. Blood, Jr., former president of the Electric Vehicle Association; "Recognition of the Electric," by Hayden Eames of the Standard Electric Car Company; "The Electric Vehicle Association," by A. Jackson Marshall, executive secretary of the electric Vehicle Association; "What Constitutes a Good Electric," by A. C. Faeh of the Rauch & Lang Carriage Company; "Utility of the Electric Vehicle, Pleasure and Commercial," by A. J. Bartlett, Baker Motor Vehicle Company; "Garaging and Service," by J. C. Bartlett of the Bartlett Garages, Philadelphia; "The Relative Fields of Gasoline, Electric, and Horse Trucks," by H. F. Thomson, Massachusetts Institute of Technology; "Touring by Electric Automobiles," by J. S. Codman, S. R. Bailey & Co., Boston; "Competition, Fair and Unfair," by Vere Shaw of the Peerless Motor Car Company; and "Weak Links in Electric Truck Salesmanship," by F. Nelson Carle of the General Vehicle Company.

An open business forum was conducted by Converse D. Marsh of New York. On Tuesday afternoon, a visit was made to the very large and complete electric garage of the Edison Company at the Service Building, which afforded an opportunity of noting how the Edison fleet of some eighty-five electric vehicles is cared for. A beefsteak dinner was served later in the Edison Service Building, adjacent to the electric garage. On Wednesday afternoon, electric vehicles conveyed all those attending the convention to Bass Point where a very interesting baseball game was played between the Edison Company employees and representatives of Electric Vehicle interests, the game being won by the former.

Canadian Electrical Association
Convention, Montreal,
June 24, 25, 26

Electric Machinery at the Panama Exposition

The Department of Machinery has been actively engaged upon the allotment of space in the Palace of Machinery. The area of this building is 369,600 sq. ft. The exhibits will comprise, it is claimed, the finest collection of electrical and machinery exhibits ever assembled under one roof and the exhibitors are co-operating with the Department of Machinery in associating their exhibits with others which will permit of complete operation and demonstration of the working of the various machines and electrical exhibits. On April 1st preliminary work was started on the installation of the first exhibit, a 500 h.p. marine Diesel engine, by the Busch-Sulzer Brothers Diesel Engine Company. The installation will cost $70,000.

The entrances to the Palace of Machinery will be handsomely decorated with palms and shrubs which will afford a pleasing surprise to those who may expect to find only a dry display of pieces of machinery. To attract the non-technical visitor many spectacular exhibits have been arranged and it is believed that the Palace may be made the most popular of the exhibit buildings. Several of the exhibitors have arranged, through the operation of pumps, etc., beautiful and artistic effects, such as water-falls and illuminated fountains.

The latest and most modern-approved methods of illumination will be displayed in connection with the exhibits in the Palace of Machinery and will be of interest to the layman as well as to the student and those vitally interested in such affairs. One phase will be especially interesting; the isolated electric-house-lighting system for farm use compared with the most complicated systems in use for city lighting.

The testing of high-potential insulators and transformers will be made possible by the arrangements which have been made with the largest manufacturers of high-voltage testing apparatus and many spectacular effects have been prepared by the use of such instruments.

A feature of the Palace of Machinery will be the methods employed for the convenience of the visitors. A number of plans are now being tested to ensure engineers and students the opportunity to make a careful examination of each exhibit in privacy and comfort. Reception spaces will be provided in connection with each exhibit and equipped with suitable fixtures which will enable technical visitors to prepare notes on the various features.

All of the working exhibits—and it is now certain that a large percentage will be in actual operation—will be equipped with the latest "safety first" devices and these guards will form one of the most interesting exhibits to the engineer and manufacturer.

The Department of Machinery of the Exposition will soon take formal possession of the offices which have been built inside the Palace on a mezzanine and will remain there until the close of the Exposition. The gates of the Exposition will open on February 20, 1915, and will close on December 4th, 1915. Nine of the eleven principal exhibit buildings are now complete and the others will be finished within 30 days.

Program N. E. L. A. Convention

The annual convention of the National Electric Light Association will be held this year in Philadelphia on June 2, 3, 4 and 5. Following is the program.

Tuesday, June 2

General Session, 10.00 a.m.,—

1. Welcome to the City.
2. Address of President McCall.
3. Announcements.
4. Report of Committee on Organization of the Industry, H. H. Scott.
5. Report of Secretary, T. C. Martin.
6. Report of Insurance Expert, W. H. Blood, Jr.
7. Report of Committee on Progress, T. C. Martin.
8. Report on Question Box, S. A. Sewall.
9. Paper, "Safety First," Paul Lupke.

Technical Session, 2.30 p.m.,—

1. Report of Committee on Meters, P. H. Bartlett.
2. Report of Committee on Grounding Secondaries, W. H. Blood, Jr.
3. Report of Committee on Electric Measures, A. E. Kennelly.
4. Address, "Electric Vehicle," C. P. Steinmetz.

Accounting Session, 2.30 p.m.,—

1. Address of the Chairman of the Section, H. M. Edwards.
2. Report of Library Committee, C. L. Campbell.
3. Report of Question Box Committee, E. C. Scobell.
4. Paper, "Cost and Statistics," Thos. J. Walsh.

Commercial Session, 2.30 p.m.,—

1. Address of the Chairman of Section, T. I. Jones.
2. Report of Finance Committee, E. L. Callahan.
3. Report of Membership Committee, J. F. Becker.
4. Report of Publications Committee, Douglass Burnett.
5. Report of Committee on Education, F. C. Hendershott.

Wednesday

Technical Session, 10.00 a.m.,—

1. Report of Committee on Electrical Apparatus, L. L. Elden.
2. Paper, "Temperature and Its Relation to the Limiting Capacity of Electrical Apparatus," F. D. Newbury.
3. Report of Committee on Underground Construction, P. Torchio.
4. Report of Committee on Overhead Line Construction, Thomas Sproule.

Accounting Session, 10.00 a.m.,—

1. Report of Committee on Rate Research, E. W. Lloyd.
2. Address.
3. Report of Lamp Committee, F. W. Smith.

General Session, 8.00 p.m.,—

1. Action on Report of Public Policy Committee, Arthur Williams.
2. Presentation of Proposed Constitutional Amendments, F. W. Frueauff.
3. Report of Treasurer, W. F. Wells.
4. Election of Nominating Committee.
5. Appointment of Committee on Resolutions.
6. Music.

Public Policy Session, 8.45 p.m.,—

1. Reading of Report of Public Policy Committee.
2. Address.
3. Music.

Thursday

Hydro-electric Session, 10.00 a.m.,—

1. Chairman's Address, W. W. Freeman.
2. Report of Committee on Hydro-Progress, T. C. Martin.
3. The Nature of Electrical Distribution in Transmission Work, D. B. Rushmore.
4. Report of Committee on Distributing Lines, P. M. Downing.
5. "Permanent Methods of Measuring Water in Water Power Plants," D. W. Mead.
6. Paper, "Water Power Plant Economics," O. B. Coldwell.

Accounting Session, 10.00 a.m.,—

1. Paper, "Accounting for Merchandise Sold," H. B. Lohmeyer.
2. Paper, "Suspense Accounts," Fred Schmitt.
3. Paper, "Mechanical Auditing and Tabulating Systems,"

(a), "In Connection with Disbursement Accounts," F. A. Birch; (b), "As Applied to Inventory of Transmission and Distribution Systems," G. L. Knight and C. V. Woolsey.

4. Accounting for Coal Consumed, A. L. Holme.

Commercial Session, 10.00 a.m.,—

1. Report of Committee on Non-Peak and High-Load Factor Business, G. H. Jones.
2. Report of Committee on Interurban Lighting Highways, G. B. Tripp.

Technical and Hydro-electric Session, 2.30 p.m.,—

1. Report of Committee on Prime Movers: (a), Steam, I. E. Moultrop; (b), Hydraulic, J. E. Vaughan.
2. Selection of Hydraulic Turbines, Chas. V. Seastone.
3. Report of Committee on Street Lighting, J. W. Lieb, Jr.
4. Report of Committee on Accident Prevention, M. J. Insull.

Commercial Session, 2.30 p.m.,—

1. Report of Committee on Wiring New or Existing Buildings, R. S. Hale.
2. Report of Committee on Electrical Merchandising and Advertising, Parker H. Kemble.
3. Report of Nomination Committee.
4. Election of Officers.

Friday

1. Report of Committee on Award of Doherty Medal.
2. Symposium, "Relations with Geographical Branches of the N. E. L. A."
3. Address, "Plans for Electrical Development," J. M. Wakeman.
4. Report of Committee on Memorials, T. C. Martin.
5. Report of Committee on Constitutional Amendments, F. W. Frueauff.
6. Vote on Constitutional Amendments.
7. Report of Committee on Resolutions.
8. Report of Nominating Committee.
9. Election of Officers.
10. Adjournment.

B. C. E. R. Personals

As previously announced Mr. R. H. Sperling has been promoted by the London board of the B. C. E. R. Company to the position of assistant to the chairman of the board, Mr. R. M. Horne-Payne, and a seat as director of the company. In succession to Mr. Sperling, Mr. George Kidd has been selected for the position of general manager, the appointment to date from May 6th. In assuming his new position, General Manager Kidd stated that the alteration in the post of general manager did not mean any change in the general policy of the company. As far as conditions permitted the company's work would be carried out along the same lines as in the past.

Mr. Sperling the retiring general manager of the company has been associated with its work in British Columbia for 18 years. He started at the foot of the ladder in connection with the company's light and power system at Victoria and mounted every step until he was appointed to the position of electrical engineer. In 1901 he was transferred from Victoria to the company's head office at Vancouver, assuming the duties of general superintendent and chief engineer. In this capacity he gave special attention to the development of the company in the electrical field, showing in this work extraordinary ability in the field of electrical engineer. In 1905 he was promoted to the position of general manager of the company on the retirement of Mr. J. Buntzen as a result of the latter's appointment as a director of the concern. Mr. Sperling will leave British Columbia during July and take up residence in London in connection with his new duties at the company's London offices upon which he will enter about August 1st. The post to which he was promoted is a new one and has been created because of the rapid development of the company's work and the advisability of having an executive at the London office who is fully in touch with the company's operations in its actual field of work. The press throughout the territory covered by the B. C. Electric have unanimously expressed through the editorial columns their appreciation of the good work which has been done by Mr. Sperling during his term as general manager of the company.

Mr. George Kidd

Mr. George Kidd, the new general manager has been connected with the company's offices both in London and British Columbia. He was appointed secretary to the company in connection with its London work in January, 1908, when he was transferred to British Columbia. He has since been located at the head office of the company in Vancouver, filling the position of comptroller. When Mr. Sperling recently left for the old country to personally confer with the London board concerning the promotion which had been offered him, Mr. Kidd was appointed acting general manager during his absence. This action on the part of the London

Mr. W. G. Murrin

board foreshadowed the permanent appointment now announced.

Announcement is also made by the British Columbia Electric Railway Company of the promotion of Mr. W. G. Murrin to the position of general superintendent with headquarters at Vancouver. His work will cover the duties of mechanical superintendent, controlling equipment over the company's entire system and the supervision of the Vancouver and suburban division of the street railway system, the most important division on the company's lines. Mr. Murrin came to British Columbia from the old country in 1913 after 13 years' experience as an electric railway executive officer. He obtained his early technical training at Finsbury Technical College, after which he served his apprenticeship in the shops of the Lighting Company of the City of London. After service with the Middlesborough and Stockton Tramway Company he was appointed superintendent of power on the London United Tramways and later promoted to the position of manager of rolling stock and electrical equipment, and works manager in the same company. He then came to Canada to act as mechanical superintendent for the British Columbia Electric Railway.

Electrically Operated Railway Gates

Coincident with their extensive scheme for terminal and dock improvements at Vancouver, the Canadian Pacific Railway Company have installed new electrically operated control railway gates to protect the crossing at Columbia Avenue, North Vancouver Ferry and the approach to the property of the Grand Trunk Pacific Railway Company. The installation was undertaken with the primary object of making the gates self-stopping at certain points.

The initial work of construction consisted of the erection of two 12-in. x 12-in. wooden posts with grooves. The gate runs in these grooves and is raised by two ⅝-in. ropes which pass over pulleys and down to a 12-in. drum in a concrete pit below. This drum is geared to a type M.S. 6 h.p., three-phase, 500 volt, 720 r.p.m. Westinghouse high resistance squirrel cage motor which provides the gates with a speed of 7 feet per minute. The motors have a magnetic brake attached to the shaft, the brake being installed with the object of stopping the gates immediately the power is cut off. Altogether seven of these equipments have been installed.

The controlling centre for all gates is a watchman's tower but at a point which provides an uninterrupted view of their operations. A 3-phase No. 8 lead-covered primary service extends underground from each gate to the tower and is connected to a Westinghouse seven-panel switchboard, each panel equipped with two 2-pole, fifty ampere interlocking magnetic switches, one for upward movement and the other for the lowering of the gate. These switches in turn are controlled by a push button panel board containing twenty-one buttons in all, mounted on a desk-type slate panel, giving the operator a clear view of every button. Three push buttons are required for each gate, one each to operate the movements of the magnetic switch and one to stop at any position. It is necessary to use the stop button only when the gate is in any part way position, as, for instance, when a team may be passing through after the gate has started to come down.

Leading from the control circuit, four No. 14 wires have been carried to two hatchway switches, one at the upper limit and the other at the lower. On the gate is fastened an iron strap about 2 feet long and bowed at each end to engage the limit switch, the limit switch in turn operating the control circuit of the magnetic and arresting the movement of the gate independently of the operator. The latter action is possible only in the direction in which the gate is travelling, the circuit in the other movement still being complete and allowing the operator to move the gate in the opposite direction.

In order to install an electric bell on each gate for the purpose of sounding an alarm before lowering, the push buttons were lengthened for the downward movement, providing two extra contacts which this button engages before engaging the control circuit operating the magnetic system, and therefore making the bells ring first. The bells are style A.A. 30, Railway Supply Company's standard crossing bells, operated by a battery.

The lighting of the gates when lowered is accomplished by placing two copper spring contacts on the groove in which each gate operates and two copper plates on the gates to engage the springs when they reach the bottom, the springs closing the circuit and lighting a 16 candle-power carbon lamp enclosed in a water-tight fitting.

This entire system has just been completed within the last few weeks and is operating successfully. The work of installation was under the direct supervision of Mr. H. C. Chambers, chief electrician of the Canadian Pacific Railway, British Columbia division.

Mr. Parent's Report

Mr. Parent, superintendent of lighting for the City of Montreal, has submitted to the controllers a report of the cost of a municipal plant for the central districts. The capital expenditure is put at $172,667, and the annual operating expenses at $54,100, bring the cost per lamp to $108 per annum. The report was compiled as the result of a dispute with the Montreal Light, Heat and Power Company as to the cost of lighting streets by means of underground distribution, the controllers considering the price of $156 per lamp per annum asked by the company too high. The increase in cost was due, according to the company, to the short term of six years during which the contract will run, and at a conference, which followed the submission of Mr. Parent's report, the company offered to reduce the price to $96.40 provided the Controllers would extend the period of the contract to 16 years. The price quoted included the entire equipment or $90.98 if the city supplied the standards, and $70.36 if the city supplied the lamps, standards and cables. The present price is $72 per lamp.

Judgment Favors T. E. L. Co.

A judgment of considerable importance has been handed down by Mr. Justice Middleton regarding the rights of the Toronto Electric Light Company in the new sections of the city of Toronto. The judgment states, in effect, that the franchise of the Toronto Electric Light Company gives them the same rights in the newly annexed districts as within the original city boundary lines. It is pointed out that it was the evident intention of the original contract for the company to serve the whole city and that the consent of the city had been given from time to time for the erection of poles and the supply of service in the earlier additions to the old limits. It is intimated in the judgment that the city of Toronto is endeavoring to destroy the business, the purchase of which they are at the present moment considering. The judgment throughout may be considered an unconditional win for the company.

Under the guidance of Mr. R. M. Wilson and Mr. Julian Smith, the engineers, a party of shareholders and others visited the hydro-electric power plant of the Cedars Rapids Manufacturing and Power Company being built at Cedars, P.Q. Over 1,500 men are now engaged in carrying out the contract, which is in the hands of Fraser, Brace and Company. It is expected that water will be let into the canal constructed through the rapids by November 1st.

Insulation Resistance Research

By S. Evershed

During recent years a great deal of valuable research work has been done to increase our knowledge of the properties of insulating materials, yet notwithstanding the progress so made the natural laws governing insulation resistance are but little understood. So little, that if at the outset of this paper a plausible statement were made to the effect that the insulation resistance of an electrical system depended mainly upon the dielectric properties of the insulating materials, it might easily pass unchallenged. Possibly some objectors might be found among those who have to maintain the insulation of electrical plant; for no one who has had much experience of the behaviour of insulation in practice, could fail to be struck by the disparity between insulating materials under test in the laboratory and the same materials under the ordinary conditions of use.

It is, of course, easy to guess that the disparity is generally due to the presence of moisture, and in fact the only insulating materials whose behaviour in use corresponds with their predetermined dielectric properties are those which are non-absorbent. Of the remainder, and they form the majority of the materials in common use, we can only predict that the insulation resistance of any electrical system in which they are used will be governed almost entirely by the moisture they absorb. Everyone knows that insulation resistance decreases on a damp day and recovers during dry weather. It is perhaps not so generally known that in most cases insulation resistance decreases, in a perfectly definite way and almost instantaneously, as the electric pressure upon it is increased, and slowly recovers if the pressure is restored to the initial value or cut off altogether. The connection between these two facts is by no means obvious, yet they are so closely related that if we succeed in explaining one of them we shall certainly understand the other. It is often useful to attempt to explain familiar things; facts which, like the effect of a damp day on insulation, are so natural as to require no explanation—until we begin to think about them.

The effect of moisture, the effect of voltage, the effect of polarity, these and other phenomena commonly met with in insulation have been forced upon the author's attention for many years past, and the pressing need to find answers to the questions that so frequently arise in connection with insulating materials induced him to undertake an experimental research with a view to the better understanding of their behaviour in everyday use. This work has been in progress for three years, most of the time being spent in finding a firm basis for future work. But certain experiments have already thrown some light on matters which have hitherto been obscure, and the object of this paper is to render the knowledge so gained available for all those who are interested in the insulation of electrical plant. The specialist will find herein much with which he is well acquainted; but insulation largely concerns those who have no special knowledge about it, and on that account many things have been introduced into this paper in order to give a general view of the subject.

What is the margin between the working voltage and breakdown? That is the fundamental question at the root of every inquiry into the properties of insulation. If a definite answer is ever forthcoming, it will not have been found in "blind" tests of breakdown voltage. To conduct tests without any means for ascertaining what is going on in the insulator as the breakdown voltage is approached, without either observing the current or, better still, the resistance, is to shut our eyes and deliberately avoid looking for the cause of failure. The author has therefore sought, by investigating the nature of leakage conduction, to establish some definite relation between applied potential difference and insulation resistance. If the curve expressing this relation be traced from a few volts up to the breakdown point, it will be found to consist in general of two parts of opposite curvature more or less like the voltage-resistance curve shown in Fig. 1. The two parts of the curve will be joined together by an approximately straight line, the length of which varies greatly according to the nature and condition of the insulation. This connecting link is sometimes so short that the two parts of the curve appear to meet at a point of inflexion and they then form a sort of ogee curve.

The research had not proceeded very far before it was realized that the shape of the first part of this characteristic curve is determined by the extent to which leakage is due to moisture, and further that leakage through the substance of the insulator—dielectric leakage—was negligibly small compared with that caused by the merest trace of moisture. This leads to the point of view that for most practical purposes an insulator may be regarded as having no inherent conductivity, the conducting power which it appears to possess being usually caused by leakage over damp surfaces. If the insulator is porous then the leakage surfaces are not only those outside the insulating body but those surfaces which bound the maze of capillary channels inside the porous material. If this idea be provisionally accepted at the outset the facts brought out by the experiments will be found to fall easily into their places, and a fairly consistent view of leakage conduction will be obtained. The research divided itself quite naturally into two parts corresponding to the two significant parts of the characteristic curve. The investigation of the second or breakdown part of the complete curve (see Fig. 1) is still in the preliminary stage, and the present paper deals mainly with the first part up to the point or region of inflexion.

Summary and Conclusion

This vision of what goes on inside an absorbent insulator, misty and imperfect as it is, provides an explanation in general agreement with the facts. In putting it forward the author is conscious of difficulties and obscurities which leave the mind doubtful, but the doubts are just those which come from ignorance of the precise structure of absorbent bodies and the mode in which they harbour moisture. In all probability the microscope would dispel a good deal of this cloud of ignorance if it were applied to some typical material like a thread of cotton.

But the facts which have emerged from the investigation leave no room for doubt as regards the main characteristics of insulation resistance under working conditions.

The true dielectric resistance of insulation is enormous compared with the actual insulation resistance obtained in practice, and in all ordinary cases we need only consider the leakage which takes place through films of moisture condensed on the external and internal surfaces of the insulating material. Dielectric leakage is insignificant and may be left out of account.

The quantity of water in the conducting films of moisture is not only very small, but it forms an exceedingly small proportion of the whole volume of absorbed water.

Impregnating an absorbent insulator with oil or varnish delays the absorption of water and no doubt limits the amount absorbed, but it does not prevent the ultimate formation of the moisture films which constitute leakage paths.

Conduction through absorbent insulation does not follow Ohm's law. The relation between the resistance of an absorbent insulator and the potential difference which is applied to it is expressed by a curve which is characteristic of conduction by films and drops.

When the absorbed water exceeds the amount which the material can hold in the form of dormant water and leakage films it begins to form conducting paths of constant resistance. Hence the moisture curve gradually decreases in curvature as absorption goes on, and ultimately when the resistance has fallen to a very low value the curve is reduced to a horizontal straight line, indicating conduction by Ohm's law.

In compound insulation consisting of an insulator in which conduction follows Ohm's law, in series with an absorbent material which follows the law of moisture conduction, the resultant curve has less than the normal curvature.

The degree of curvature in the characteristic curve of compound insulation enables the resistances of the two components to be separately estimated.

In compound insulation a curve of normal curvature indicates failure of the dielectric component. A straight horizontal "curve" (Ohm's law) indicates failure of the absorbent component.

Finally, the broad principle of film conduction in an absorbent insulator is clear; the moisture curve—the first part of the complete characteristic curve—is the direct result of electric endosmose. The electrically produced hydraulic pressure drives dormant water into the films, and their increasing thickness is made evident by the gradual fall in resistance as the potential difference is increased.

At what point leakage through moisture becomes dangerous; whether the ultimate effect of prolonged endosmosis is to safeguard the insulation by driving all the water away from the positive conductor in a continuous-current system, and from both conductors if the supply is by alternating current; whether it is possible to predict the breakdown voltage—these and other questions can only be answered by an investigation of the second part of the characteristic curve. Preparations for this are not yet complete, and so far it has only been possible to extend the curve to the breakdown point in one or two simple cases for which the voltage already available proved sufficient. In these examples the curve began to bend downwards at pressures well below the breakdown value, thus indicating the impending failure without exposing the insulation to the risk of permanent injury. It remains to be seen whether this useful effect is general, or whether, as seems more probable, it is confined to insulating materials in which failure begins along already existing leakage channels. It is a significant fact that in the model insulator breakdown begins in the form of sparking along the films from one drop to another. Questions of this kind go to the very root of the matter. It is customary to account for breakdown by dielectric stress; a blackened hole appears in the insulation and the inference is too hastily drawn that the puncture process was instantaneous and could not have been foreseen by any kind of test. But nothing in Nature, not even an explosion, takes place instantaneously, and the breakdown of an insulator is only sudden to the mind that does not apprehend it.

The time may never come when it is possible, by systematic insulation testing, to forestall breakdown by diagnosis of the disease and removal of the cause. To-day the problem as a whole looks wellnigh insoluble, and with no visible goal ahead of us we must be content to gain a clearer insight as we go along in more or less the right direction.

Personal

Mr. R. M. Hannaford, assistant chief engineer, Montreal Tramways Company, has been elected second vice-president of the Canadian Railway Club.

Mr. F. A. Gaby, chief engineer, Hydro-electric Power Commission of Ontario, was married on May 20 to Miss Catherine Florence Macbeth, Toronto.

Mr. W. J. Camp, assistant manager C. P. R. Telegraphs, was present at the annual meeting of the Association of Railway Telegraph Superintendents held at New Orleans.

Mr. S. W. Canniff, formerly on the staff of the Canadian General Electric Company, has been placed in charge of the meter department and transformer tests of the Ottawa Municipal Electric System.

Cost of Electricity at the Source

By H. M. Hobart[1]

By the time electricity is delivered on the premises of small consumers such considerable costs will have been incurred that the price admitting of any profit can rarely be less than some where from two cents to eight cents per kelvin.[2] The original cost of manufacturing in bulk, however, is a far less amount. It is desirable that this should be more generally realized as it indicates the great field for electricity for large manufacturing enterprises which can be located near the source of electricity supply. Under favorable conditions electricity can be manufactured in bulk at a cost of the order of 0.25 to 0.40 cent per kelvin.

In an address delivered by Ferranti in 1910, the proposition was formulated that, on certain assumptions, a station equipped with ten 25,000 kw. generating sets could be built at a total cost of $35 per kilowatt. I have made estimates which indicate $35 per kilowatt to be sufficient for a 100,000 kw. station equipped with five 20,000 kw., 1,800 rev. per min., steam turbine driven, three-phase generators and all the machinery required in such a plant. As a matter of interest it may be stated that the outlay for the turbo-generators, cables, exciters, and switchgear is covered by 30 of this $35 per kilowatt. (In and near large cities this sum would be insufficient, since the outlay for land and buildings would then be at least $10 per kw.).

The following estimate for the cost of electricity when manufactured in such a station, will be based on the Stott-Gorsuch method, in accordance with which the total cost is considered as made up of three components. These three components are:

1. Production Costs.
2. Investment Costs.
3. Administration Costs.

I shall divide the Production Costs into two items, A and B.[3]

Item A relates to all components of the Production Costs except fuel. Item B relates to the cost of fuel. While A will vary by a small amount with the load factor, I shall neglect this variation and take:

Item A = $700,000[4]

Item B: In estimating the annual outlay for fuel we must first have data for the overall efficiency of the station. From an examination of the thermal efficiencies of turbo-generating sets and steam raising plant, one would be led to expect overall efficiencies from the coal to the outgoing cables ranging from at least 18 per cent. for unity load factor down to at least 16 per cent. for a load factor of 0.50. But reasoning from the results actually obtained in practise it is not considered that it would be conservative to take values higher than the following:

Load factor	Overall efficiency
1.00	15 per cent.
0.75	14 per cent.
0.50	13 per cent.

Assuming the maximum load from our 100,000 kw. station to be 80,000 kw., the annual output for these three cases is:

Load factor	Annual output in mega-kelvins
1.00	700
0.75	525

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[1] Read before the A. I. E. E.

[2] In this paper the term kelvin is employed instead of the term kilowatt hour.

[3] Item A covers wages, repairs, lubricants, water, supplies, etc.

[4] It is believed that an analysis will show this value to be reasonably representative for Item A and that in so far as it errs it is in the direction of being conservative. It will cover any investment costs, associated with the water supply, such as cooling towers when required.

0.50	350

The energy in the coal consumed per annum amounts to:

Load factor	Mega-kelvins of energy in the coal
1.00	4660
0.75	3750
0.50	2690

The estimates may be based on coal with a calorific value of 12,000 B.t.u. per pound. 1 kelvin equals 3,411 B.t.u. Consequently each (2,000-lb.) ton of coal contains:

$$\frac{12{,}000}{3411} \times 2{,}000 = 7{,}000 \text{ kelvins}$$

The quantity of coal burned per annum is as follows:

Load factor	Quantity of coal burned per annum
1.00	667,000 tons
0.75	535,000 tons
0.50	384,000 tons

In the following table are set forth the outlays for fuel on the basis of 50 cts. per ton and $5 per ton.

Load factor	Annual Outlay for Fuel 50cts. per ton	$5 per ton
1.00	$334,000	$3,340,000
0.75	268,000	2,680,000
0.50	192,000	1,920,000

The above amount represents Item B, the fuel component of the production costs per annum. We have already stated that for the remaining component of the production costs. (Item A), we shall take the constant value of $700,000.

Adding A and B we obtain the total production costs set forth in the following table.

Load factor	Production Costs per Annum Fuel at 50 cts. per ton	Fuel at $5 per ton
1.00	$1,034,000	$4,040,000
0.75	968,000	3,380,000
0.50	892,000	2,620,000

In terms of cents per kelvin, the above production costs are:

Load factor	Production Costs per kelvin Coal at 50 cts. per ton	Coal at $5 per ton
1.00	0.148 cent	0.576 cent
0.75	0.184 cent	0.645 cent
0.50	0.254 cent	0.750 cent

We now come to the second component of the total cost, namely the investment costs. At $35 per kilowatt the initial cost of the 100,000 kw. station is $3,500,000. This is sufficient to cover engineering supervision and contingencies.

On the basis of:

Interest	5.0 per cent.
Rates, taxes and insurance	3.0 per cent.
Amortization	4.6 per cent.
Total annual charge on investment[5] ..	12.6 per cent.

we arrive at an Investment Cost per annum of

$$0.126 \times 3{,}500{,}000 = \$441{,}000.$$

In terms of cents per kelvin the Investment Costs are:

Load factor	Investment costs per kelvin
1.00	0.063 cent.
0.75	0.084 cent.
0.50	0.126 cent.

As to the final item in the total cost, namely the administration costs, let us distinctly limit this item to the bulk manufacturing undertaking. Let the marketing of the electricity be separately handled by another undertaking. With this understanding, an allowance of $100,000 per annum is reasonable for administration costs. This provides for an administrative organization simply concerning itself with manufacturing the electricity and delivering it at the outgoing cables. Per kelvin, this amounts to:

Load Factor	Administrative Costs per kelvin
1.00	0.014 cent
0.75	0.019 cent
0.50	0.029 cent

The total costs are worked out in the following table in which production costs are indicated by I, investment costs by II, and administration costs by III.

Load Factor	Component and Total Costs in Cents per kelvin Coal at 50 cents per ton	Coal at $5 per ton
1.00	I = 0.148 cent II = 0.063 " III = 0.014 " Total = 0 225 cent	I = 0.576 cent II = 0.063 " III = 0.014 " Total = 0.653 cent
0.75	I = 0.184 cent II = 0.084 " III = 0.019 " Total = 0.287 cent	I = 0.645 cent II = 0.084 " III = 0.019 " Total = 0.748 cent
0.50	I = 0.254 cent II = 0.126 " III = 0 029 " Total = 0.409 cent	I = 0.750 cent II = 0.126 " III = 0.029 " Total = 0.905 cent

These total costs are plotted in Fig. 1 with cost of coal as abscissas. They are plotted in Fig. 2 with load factors as abscissas.

For water power stations, if there is no charge for the water, and if the total investment can be kept as low as $35 per kilowatt, the lowest curve in Fig. 2, (i.e. the curve for fuel at a negligible cost per ton) may be taken as affording a fair indication of the cost of electricity at the source.

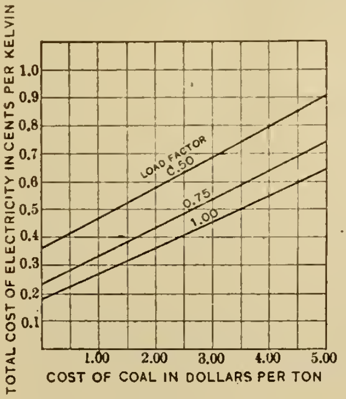

FIG. 1

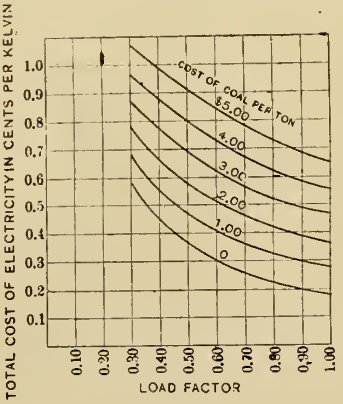

FIG. 2

This investigation has been based on the assumption that the electricity delivered from the station is of unity power factor. For lower power factors the total cost of the electricity will be higher. Professor Arno of Italy has devoted a great deal of study to the influence of the power factor on the cost of electricity and has arrived at the conclusion that for practical purposes the cost may be taken as proportional to two-thirds of the true output, plus one-third of the apparent output (i.e., the true output divided by the power factor). Thus if we take the case of our 100,000-kw. station when the load factor is 0.50, we have seen that the cost, with coal at 50 cents per ton, is 0.409 cents per kelvin for unity power factor. If the load is of 0.80 power factor the cost by the Arno rule will be:

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[5] For other capital costs per kw. and for other rates and other depreciation assumptions the corresponding annual investment costs are readily deduced. Those adopted in this investigation would appear representative for such a station.

$$\left\{ 0.667 + \frac{0.333}{0.80} \right\} \times 0.409 = 0.444 \text{ cent. per kelvin}$$

Prof. Arno's rule may be regarded as a useful approximation for representative conditions. The application of the present method of analysis to outputs of different power factors would show that no such simple rule would suffice. The influence of the power factor would for instance be much affected by the ratio of the cost of fuel to the total costs, and would be different with different load factors.

Indeed a similar general criticism applies to Mr. Stott's nevertheless useful approximate rule that the production costs may be taken as inversely proportional to the fourth root of the load factor. There may be wide deviations from such a rule occasioned by extremes in cost of fuel and in other conditions.

Furthermore the costs which we have worked out have related to delivering 60-cycle three-phase electricity at the pressure at which it is generated, say 10,000 volts. If it is to be stepped up to, say, 100,000 volts, to be transmitted in bulk to a distance, then the cost at the high-pressure side of the step-up transformers may be obtained as follows:

Let us take the case of a load factor of 0.50 and coal at 50 cents per ton. Let the power factor be unity. The cost under these conditions has been estimated to be 0.409 cent per kelvin. We shall require to provide step-up transformers with an aggregate capacity of 100,000 kw. Their cost would be of the order of $2.70 per kilowatt making a total outlay of $270,000. The annual outlay for interest, rates, taxes, insurance, amortization, repairs and attendance may be taken as:

$$0.15 \times 270{,}000 = \$40{,}500.$$

The annual output from the station when the load factor is 0.50 has already been estimated to be

350 mega-kelvins.

Taking the annual overall efficiency of the transformers as 97.5 per cent. the output from the transformers is

$$350 \times 0.975 = 341.5 \text{ kelvins.}$$

Therefore the step-up transformer costs, per kelvin delivered from them, are

$$\frac{4{,}050{,}000}{341{,}500{,}000} = 0.012 \text{ cent.}$$

The total cost per kelvin delivered from the step-up transformers is

$$\frac{350.0}{341.5} \times 0.409 + 0.012 =$$

$$0.419 + 0.012 = 0.431 \text{ cent.}$$

Thus the cost has increased 5.5 per cent. by the time the pressure has been stepped-up. This paper is entitled "The Cost of Electricity at the Source." By similar processes, however, the increases in cost can be traced right through to the consumers' premises. But the reasoning becomes very involved when we arrive at the stages where the electricity is no longer carried in bulk. At these stages questions relating to appraisements of value, diversity factor, ethics and commendable sentiment render it impossible to arrive at any precise method which can be conclusively demonstrated to provide for equitably distributing the total cost amongst the various consumers.

At the last meeting of the Montreal Electrical Society Mr. C. O. Von Dannenberg, of the engineering department, Montreal Public Service Corporation, read a paper on "General Notes on 66,000 volt Electrical Construction." Mr. Von Dannenberg dealt especially with sub-station work, and discussed the relative merits of different types of equipment.

Light and Power in Edmonton

Although the year 1913 was one of financial depression it would appear from a perusal of the report of the Electric Light and Power Department of the city of Edmonton, that that department was not affected by the prevailing conditions, since this report shows that the department experienced the best year it has yet had. The figures given below are extracted from the report and give a comparison between the years 1912 and 1913:

	1912 12 months	1913 14 months	% increase
Revenue from private lighting	$285,168.72	$544,583.54	91
Revenue from power	42,404.32	90,537.17	113.5
Revenue from street lighting	26,171.40	60,736.77	132.1

During the year there were issued 6,505 wiring permits as against 5,102 in 1912, an increase of 27.5 per cent. approximately, and there were connected up 3,514 lighting consumers and 112 power consumers during the year, which brought the total connections up to 11,052 and 373 respectively as against 7,538 and 252 at the end of the 1912 financial year, increases of 46.6 per cent. and 48 per cent. respectively. Considerable work was also done in extending the street lighting. At the end of 1912 there were in operation 477 arcs and 45 tungstens and during 1913 there were installed 331 arcs and 55 tungstens. Included in the total of arcs are 84 inverted C. G. E. magnetite lamps as part of a "White way" scheme, which scheme is now being completed and is further described below. During the year the meter section handled 11,152 meters, as against 7,190 handled during 1912, an increase of 55 per cent.

The figures given above are indicative of the rapid development that the capital city of Alberta has made and this is still further illustrated graphically in the accompanying curve which represents gross revenue.

It is hoped at an early date this year to complete a "White way" installation consisting of 178 C. G. E. magnetite inverted arc lamps on standards. These standards will be installed in the business sections of the city. When this work is completed the city will have a total of 262 inverted lamps in use, with a possibility of this total being added to in the near future.

The Department has also installed a lighting system on the traffic deck of the High Level Bridge which connects both sides of the river. This bridge has two decks, the upper one carrying three tracks, two being for the street railway and the other for the C. P. R. Foot passengers and vehicle traffic is provided for by a lower deck and this has been lighted by installing 76 two-light tungsten standards, set so that one light projects beyond the steel work on to the footpath and the other on to the roadway. These standards are installed on both sides of the bridge and are staggered at as uniform distances as the bridge structure would permit. Sixty c.p. 6.6 amp. series tungstens are used, each lamp being enclosed in a 12-in. Alba globe. The resulting illumination is even throughout the whole length of the bridge. The approaches are lighted by inverted C. G. E. magnetite arcs (6.6 amp.) mounted on Parkway standards.

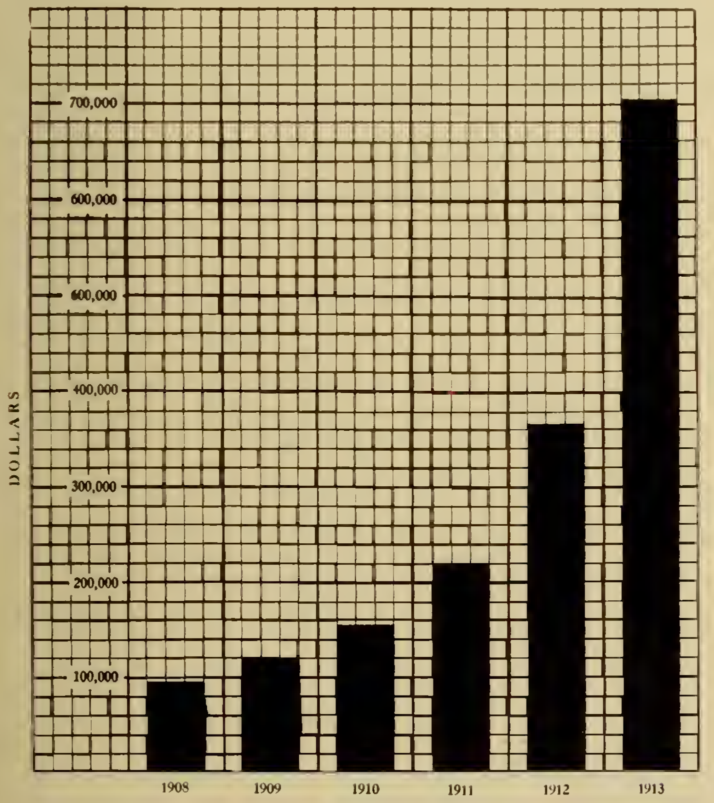
For the last week in May, May 25th to 30th inclusive, the Department has initiated a campaign to increase its day load, by encouraging the use of heating and cooking appliances. In this campaign it has received the active co-operation of all the electrical contractors and those hardware and department stores which handle these appliances. An electrical show, which will continue throughout the week, will be held in a building designed for the purpose which is on one of the principal corners in the city. Demonstrations will be made and no expense spared to make the show one which will appeal to all. It is hoped to make this exhibit one of the most attractive ever held in Western Canada, and it is the department's intention to continue the campaign throughout the summer.

Since the beginning of the present year there has been a revision of the rates and a re-classification of consumers, the rates now being as follows:—

Domestic Lighting—7½c for the first 100 kw.h.; 101 to 400 kw.h., 7c; 401 to 1,000 kw.h., 6½; 1,001 to 2,200 kw.h. 6c; 2,200 kw.h. and over, 5½c. Minimum charge per month to be 75c. Discount of 5 per cent. if paid within ten days from date of bill. No discounts allowed on accounts of less than $1.00.

Power—6c per kw.h. for the first 150 kw.h.; 150 to 300 kw.h., 5c; 301 to 5,000 kw.h., 3c; 5,001 and up, 2c per kw.h. Minimum charge on motors up to 15 h.p., 75c per h.p. per month on total connected load. Minimum charge on motors above 15 h.p., 50c per h.p. per month on total connected load. Ten per cent. discount allowed on all accounts exceeding $1.00. No bill issued for less than the following amounts,—single-phase connections 75c per month; three-phase connections $2.25 per month.

Domestic Appliances in private residences and not used for commercial purposes, such as heating, ironing, cooking and small single-phase electric motors up to 2 h.p. total connected load—4c per kw.h. A minimum charge of 50c per kilowatt connected will be charged per month. Discount of 5 per cent but no bills isued for less than $1.00 per month.



Gross earnings, Edmonton's light and power department.

Mercury arc rectifiers for battery charging or business purposes (other than moving picture machines); arcs for blue print machine and photographic purposes; heating and ironing for commercial purposes in laundries, pantoriums or other business premises, also in public schools; medical apparatus of 1 kw. or larger capacity; single-phase motors where the total connected horse-power does not exceed 3 h.p.,—5c per kw.h. for the first 375 kw.h.; 375 to 5,000 kw.h., 3c per kw.h.; 5,001 kw.h. and up, 2c per kw.h. A minimum charge of 50c per kw. or horse-power connected will be charged per month. Discount of 10 per cent. Minimum bill $1.000 per month.

Moving Picture Machines—(Arcs or Rectifiers) rate 6c per kw.h. Minimum charge $3.00 per month. Ten per cent discount.

Grounded Neutral Experience*

By J. P. Jollyman, P. M. Downing and F. G. Baum

The Pacific Gas and Electric Company operate a very extensive 60 cycle transmission network in Central California. The 60 kw. system comprises about 1,260 miles of three-phase circuit. It is supplied directly by nine hydroelectric plants having an installed generator capacity of 67,310 kw. and three steam plants having an installed turbo-generator capacity of 68,000 kw. In addition there are 14,300 kw. of steam engine-driven generators in the company's steam plants which are held in reserve. The 100 kv. system which has just been put into operation has one hydroelectric generating station of 25,000 kw. capacity and 109.5 miles of circuit. The entire output is fed into the 60 kv. system through one substation.

For the purpose of the receipt or delivery of power the 60 kv. system is connected as follows: at Chico to the 60 kv. system of the Northern California Power Company; at Santa Rosa with the 60 kv. system of the Snow Mountain Water and Power Company; at a point near Folsom with the 60 kv. system of the Western States Gas and Electric Company; and at Oakland, through transformers, with the 100 kv. system of the Great Western Power Company.

These connections very considerably increase the length of circuit and total generator capacity connected to the 60 kv. system. The entire 60 kv. and the 100 kv. systems are usually operated in parallel.

The transformers at all the company's own generating stations and at all important substations have their high-tension windings Y connected with the neutral solidly grounded. The low-tension windings of the generating station transformers are nearly all delta-connected as are also about half of the substation transformers. The remaining substation transformers have both windings Y connected with solidly grounded neutrals. In most of the substations where the low-tension windings are delta-connected, a switch is provided between the high-tension neutral and the ground, which is normally kept open. This avoids the short-circuiting of one transformer in case of a ground on the transmission system and prevents the substation being cut off from the system by the opening of the protective devices on the high-tension side of the transformers. There are over 225,000 kw. of 60 kv. transformer capacity in the company's own generating plants and substations.

The Northern California Power Company, the Snow Mountain Water and Power Company and the Western States Gas and Electric Company operate their transformers Y connected with the neutrals solidly grounded. The connection with the Great Western Power Company is through transformers connected delta to delta. This method of connection is not theoretically correct where power is to be fed from the delta-connected transformers into the grounded Y system, because a ground on one wire of the line connecting the delta-connected source of supply with the grounded Y system will impress 173 per cent. of normal voltage across the high-tension windings of two of the transformers in the grounded Y banks. The resulting disturbance in the low-tension circuits is very severe. Our experience proves conclusively that this method of connection is not desirable.

At all generating stations, and at all important junction points and substations the 60 kv. lines are controlled by oil switches. The lines are switched out under any condition of load or short circuit as occasion demands. The lines are also switched on at full voltage. We have operated in this manner for over 10 years and have never had any failures of transformers or of line insulation which could be attributed to this method of operation.

We consider that the grounded-neutral system as compared with the delta system affords the following important advantages:

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* Read before A. I. E. E.

1. With Regard to Transformers: Transformers are wound for only 57.7 per cent. of the voltage required in the delta system. The average voltage to the neutral from all points of the windings is 50 per cent. of the voltage from line to neutral; that of a delta bank is 69 per cent. The product of the turns times the average voltage to neutral in the Y connected bank is 41.8 per cent. of that in the delta-connected bank. The windings have 173 per cent. the current capacity of the windings of a delta transformer.

In addition there is only one line terminal per single-phase transformer, wiring for a spare unit is much simpler and the high-tension windings may be used as auto-transformers in supplying small amounts of power to lower voltage circuits.

The connection between the Pacific Gas and Electric Company's 100 kv. system and the 60 kv. system is made with auto-transformers connected grounded Y. We believe this to be the simplest, most reliable and most efficient connection than can be made between two such systems.

Our transformers have given so little trouble that we have not had much occasion to try to maintain service with only two transformers. We have had no difficulty, however, in carrying loads up to 2,000 or 3,000 kw. with two transformers.

Our experience confirms our belief that the fewer turns of greater current capacity and the fixed lower average voltage to ground of the transformers greatly increase their reliability.

2. With Regard to Transmission Lines: The maximum voltage on the line insulators is fixed and is never more than 57.7 per cent. of the line voltage. Ten years ago the pin type insulator was the only type obtainable and the low fixed maximum voltage of the grounded neutral system has unquestionably been of great assistance in securing the best service from this type of insulator.

It is possible to maintain polyphase service at a substation on a branch line with only two wires in the event one wire should be cut out. This cannot be done on a delta system unless one phase of the whole system be grounded and this is very undesirable.

3. With Regard to Operation: With the neutral grounded, a wire down is instantly detected and power must be immediately cut off. This is exceedingly important where many of the circuits run through thickly settled districts. Inasmuch as practically all our important loads are reached by two lines or are on a loop, service is not more than momentarily interrupted by a failure at one point.

A line of any length may be charged at full voltage without shifting the static neutral. It is impossible to close all phases of a circuit at exactly the same instant. In a delta system the first phase closed will increase the capacity to ground of that phase of the system and thereby draw the static neutral toward that phase. The second phase acts in a similar manner and the static neutral does not return to the center of the delta until the three phases are closed. This sudden shifting of the static neutral is the cause of an unnecessary strain on the insulation of the system. We know of failures from this cause on delta-connected systems.

Finally, and most important of all, is the fact that in extensive high-voltage delta-connected systems a ground is often followed by a disturbance of such power that breakdowns of insulation at other points take place. Such a disturbance generally results in serious damage to apparatus and service. The cause of this type of disturbance is found in the oscillatory character of the arc which takes place from a delta-connected system to ground. together with a large amount of current which will flow in such an arc if the system is extensive. In the event of a ground on a delta-connected system, the charging current, which is a function of the voltage from wire to neutral, will be increased because the neutral is shifted from the center of the .delta to one corner. This increase will be about 73 per cent. The current flowing in the arc to ground may be nearly equal to the increased charging current, and this on our 60 kv. system would amount to about 400 amperes. The circuit containing the arc, line reactance and capacity from line to ground tends to oscillate. Such an oscillating arc is very likely to set up disturbances of high power especially when there is any such current as 400 amperes involved. We have seen evidence that such a disturbance may cause high voltage to ground on the wire on which there is an arcing ground. This fact would probably cause the operation of an arcing ground suppressor to be very unreliable.

Certain districts in which we operate occasionally have heavy fogs which are carried in from the Pacific Ocean by the prevailing westerly winds. It has been our experience in these districts that lines on pin insulators have given better service when operated grounded Y at 60 kv. than when operated delta-connected for a much lower line voltage. It seems probable that the leakage over the insulators in foggy weather was sufficient to set up oscillatory disturbances which caused more trouble than has the higher but more stable line voltage.

We have found that the grounded Y system is entirely free from such disturbances as these. The frequency of an arc to ground is that of the system. Any damage is confined entirely to the point of failure. The short-circuit currents have not caused any damage to generator or transformer windings. Due to the distribution of the sources of power, any given point on the system will have a good many miles of line between it and several of the generating plants. Hence it is doubtful in many cases if more current would flow in a short circuit to ground than would flow to ground if the system were delta-connected. The drop over the lines from the more remote generating plants to a point at which a ground may take place serves to prevent the voltage at points removed from the trouble from dropping to zero, and therefore the service is not seriously interfered with except in the vicinity of the trouble.

We believe that the operation of our system with the neutral grounded causes less disturbance in the circuits of our neighbors, the telephone and telegraph companies, than would be the case if we operated delta-connected.

Briefly, the induction in parallel telephone or telegraph circuits is caused by any unbalanced currents in the phases of the high-tension circuit, and by the presence of voltage to ground on the line conductors. The last cause is by far the most important because the unbalanced currents during normal operation may be kept very small while the voltage to ground is always high. A ground on the grounded Y system will not cause much, if any, more current unbalanced than will a ground on a delta-connected system. The unbalanced current is at normal frequency in the grounded Y system in place of at a very much higher frequency as is usual on the delta-connected system, hence the parallel circuits are not affected so unfavorably. It is our experience that even a considerable amount of unbalanced current at the normal 60 cycle frequency has little noticeable effect on parallel telephone circuits. The unbalance will be immediately removed from the grounded Y system in all cases, whereas a delta-connected system may occasionally be operated a short time with a ground before a final shut-down takes place. The definite limit on the voltage to ground is of very great advantage to the parallel circuit.

Conclusion

The operation of our high-tension network with the grounded neutral has been entirely satisfactory. We do not believe that we could give as good service, with as high a degree of safety to the public with any other system.

The Motor-Converter--Theory and Practice

By W. A. Coates, A. M. I. E. E.

[The motor-converter is now finding its way into the Canadian field. Regina has been operating a 1,200 kw. unit since February 26 of the present year, the Canada Cement Company are installing a 250 kw. unit and the Armstrong-Whitworth Company, Montreal, have placed an order for two 350 kw. machines. In the August 15, 1913, issue of the Electrical News there appeared a brief description of this type of equipment explaining its relation to the rotary converter and the motor-generator. In view of the continued interest in these machines we are glad to be able to print a somewhat more complete description of the theory and design of the motor-converter.—Editor.]

The first commercial Peebles-La Cour motor-converter was built in Edinburgh in 1904, the covering patents having been granted to Messrs. Bragstad and La Cour some two years previously. Since that time, machines of this type have been built to a total of a quarter of a million kv.a. in Edinburgh alone.

In general construction, it may be said that the motor-converter is a combination of an induction motor-generator and a rotary converter. It consists of two machines rigidly coupled as in the motor-generator, the rotor of the a.c. end being also electrically connected with the armature, and hence the commutator at the d.c. end, thus following the rotary converter. In Fig. 1 is shown a diagram of connections.

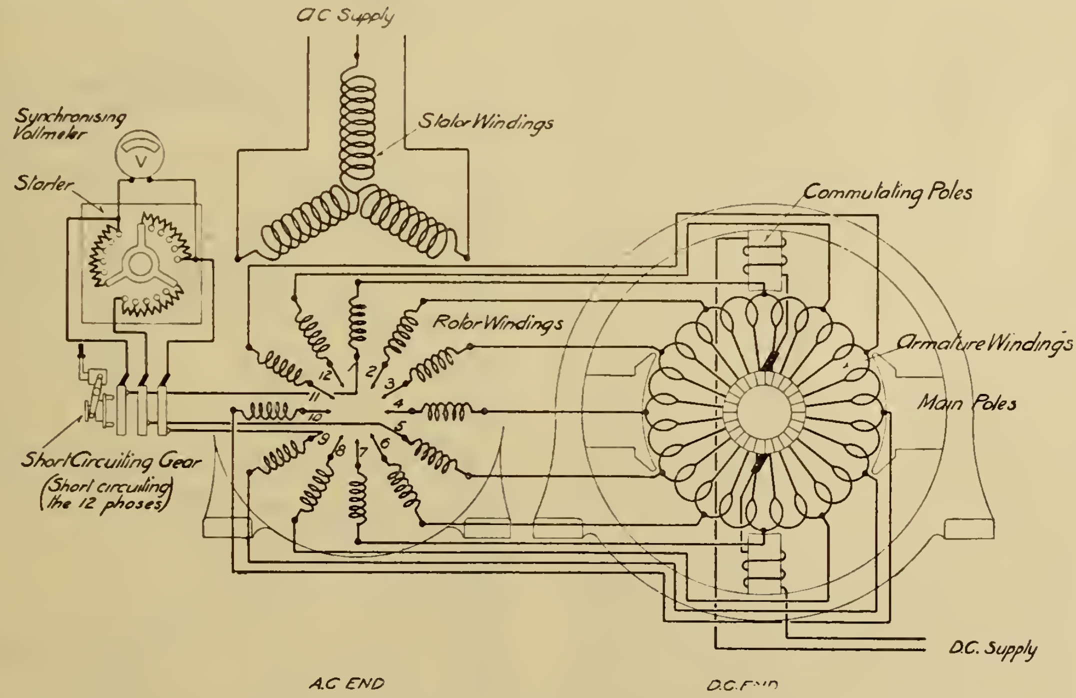


Fig. 1.—Diagram of connections of La Cour Motor-Converter.

The stator of the a.c. end is wound for direct connection to the supply system. As there is no electrical connection between this and the d.c. end, the voltage for which the stator may be wound is only limited by the same considerations of insulation as affect the design of any h.t. motor. The rotor of the a.c. machine is usually wound with twelve phases which are connected at one end to corresponding points on the armature of the d.c. machine. Three of these phase windings are connected at the other end through slip rings to a starting resistance, and all twelve windings are also brought at this end to a short circuiting device, which forms the neutral point when running. The d.c. field is in every way similar to that of the ordinary d.c. machine.

Let us assume for the moment that the a.c. and d.c. ends have both been wound for the same number of poles and that the rotating element is running at half the synchronous speed for a conventional motor with that number of poles. The stator winding will induce in the rotor of the a.c. end a revolving field which rotates relatively to the rotor itself, at a speed which corresponds to half the frequency of the supply, and the e.m.f. induced in the rotor will also be of half supply frequency. The number of poles in the d.c. field being the same as for the a.c. end, it follows that the e.m.f.'s in the d.c. armature will be of the same frequency as those in the a.c. rotor, when running at the speed assumed.

If now the windings of the a.c. and d.c. rotors be paralleled, the combined set will hold this speed, and will behave as a single synchronous machine.

In order that this may be the case, the e.m.f.'s induced in rotor and armature must balance each other. This effect is obtained by so interconnecting them that the rotor currents in flowing through the armature produce a flux which rotates in the opposite direction to the shaft, and which consequently has no motion relative to the d.c. field. It is the action between these two fields which holds the set to speed, as any variation in speed involves a relative displacement between the two fields, and sets up synchronising currents.

As the rotor revolves at a speed corresponding to half the frequency of supply, half the electrical energy supplied to the a.c. end will be transferred without change (save of voltage) through the rotor winding to the d.c. armature, and the balance will be converted into mechanical energy, and transmitted through the shaft to the d.c. armature, where it is re-generated into electrical energy. The a.c. end is therefore employed half as the transformer supplying a rotary, and half as the motor of a motor-generator set, while the d.c. end acts half as a rotary-converter and half as a d.c. generator.

The size of the a.c. machine depends on the speed of the rotating field, and not on that of the rotor, and consequently the machine may theoretically be built only half the size of a simple motor of like total kw. capacity and speed. The d.c. end may also be reduced in size below that of a similar d.c. generator, by reason of the more favorable commutating conditions. In actual practice, it is usual to design these machines with a greater number of d.c. poles than a.c. so as to obtain a still further reduction in size. In this case the machine will run at a speed inversely proportional to the sum of the poles of both machines. The speed is given by the formula:—

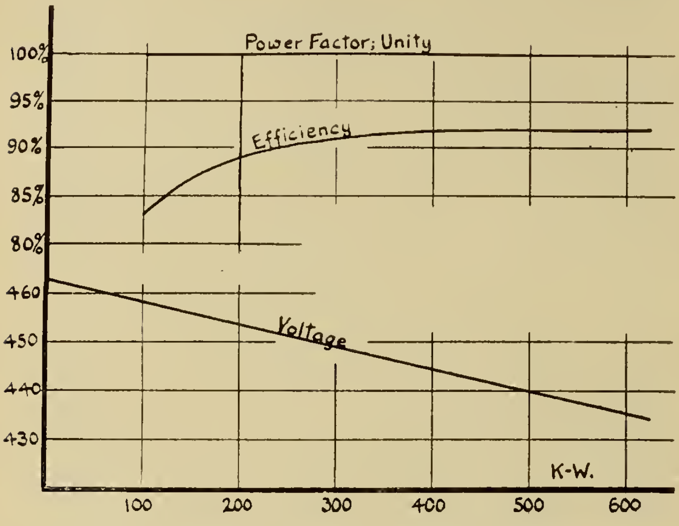


Fig. 2.—Characteristics of 500 kw. lighting unit.

$$\text{r.p.m.} = \frac{60 \times \text{supply frequency}}{\text{a.c. poles} + \text{d.c. poles}}$$

Under these conditions the a.c. end will convert mechanically:—

$$\text{kw.} = \frac{\text{a.c. poles} \times \text{kw. capacity of set}}{\text{a.c. poles} + \text{d.c. poles}}$$

The balance of the energy will be transferred from the a.c. to the d.c. end electrically as in a rotary.

In starting up these machines from rest, the stator winding is switched straight on to the a.c. supply three of the rotor phase windings being connected through slip-rings to a non-inductive resistance, and the remaining phase windings left open-circuited. The d.c. end is disconnected from the bus bars, and has its field connected in shunt for self-excitation. As the non-inductive resistance is cut out, the set comes gently up to speed, just as a slip-ring induction motor would do. As the speed approaches synchronism the rotor and armature e.m.f.'s will be alternately in unison and opposition, and a volt-meter connected across two of the slip-rings will show this condition. When the set actually attains synchronism, this instrument will cease to show any fluctuation, but will remain at zero. The starter is cut out, and the short circuiting device is closed, thus forming the common star point for all the rotor phase windings. The d.c. shunt rheostat is usually left with some resistance in, so that the set at first comes up to slightly above synchronous speed, and then automatically drops very slowly into step.

The exact proportion of shunt resistance necessary is settled when the machine is first started up. Thereafter no adjustment is required, the operator merely waiting for the voltmeter to indicate the moment to cut out the starter entirely. The simplicity of this method of start, as compared with the starting up of a synchronous motor-generator or rotary converter is very marked.

The motor-converter can be run inverted, i.e., d.c. to a.c., in which case starting from the d.c. end is accomplished with an ordinary d.c. starter, and the a.c. end is synchronised with the running plant just as would be the case with any incoming alternator unit.

When intended for use on traction systems, the d.c. machine can be compounded to give a rising characteristic, this being a distinct step in advance of the rotary converter, where over-compounding can only be obtained by using an external reactance.

The power-factor characteristics of this machine are also very interesting. A flat compounded or simple shunt machine is generally designed to give a power-factor of practically 100 per cent. at all loads, while with a rising compound winding the p.f. changes from lagging at no load and light loads, through 100 per cent. at about ¾ load, to leading at full and overload, see Figs. 2 and 3.

One of the principal features which has influenced the use of synchronous motor-generators on long distance transmission systems hitherto has been the fact that such machines can be used for power-factor correction. The extent to which such compensation can be obtained on a La Cour converter is indicated by the regulation curve Fig. 4. At periods of light load when all the machines in a sub-station are not required to handle the service, spare motor-converters may be run up with the d.c. end disconnected, and by shunt regulation can be utilized as synchronous condensers.

The efficiency of the motor-converter is considerably higher than that of a motor-generator. It is slightly less efficient than a rotary and its transformers at full load, but the curve does not drop away so quickly on lower loads, so that the motor-converter frequently has an advantage, even in this respect, on widely fluctuating loads.

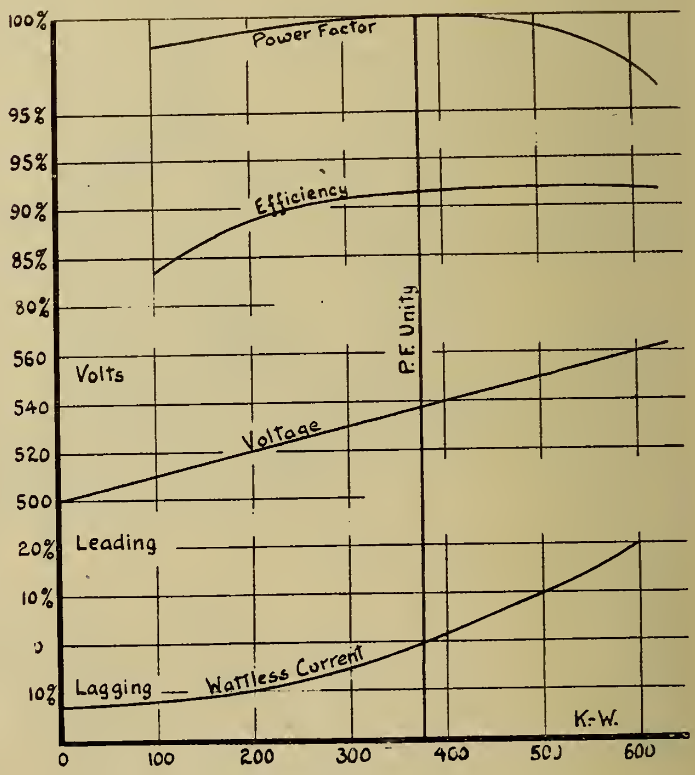


Fig. 3.—Characteristics of 500 kw. traction unit.

A feature of the motor-converter which is of special interest when traction applications are under consideration, is that the number of d.c. poles is just half that required on a rotary-converter of the same size and speed. The brush spacing is therefore increased, and the risks of a flash-over practically eliminated.

As was indicated above, the motor-converter is capable of running inverted, and when running in this manner has excellent inherent voltage regulation, even on inductive loads. Where a.c. voltage regulation is required, a synchronous booster is generally employed, unless the set is running in parallel with other synchronous apparatus, in which case the latter would supply the wattless currents required by the converters on inductive loads.

The peculiar economy of the motor-converter is most marked on 60-cycle systems. On 25-cycles the first cost on smaller sets is somewhat larger than that of a rotary, and the latter is therefore the better commercial proposition. For sets of 1,000 kw. and upwards, however, the motor-converter holds its own.

The machine actually consists of two separate frames and is usually built up with three bearings. On the smaller machines the middle bearing is sometimes omitted, and the housing extended between the a.c. and d.c. frames. In this case, the interconnecting leads from the rotor to the armature are carried direct and not through the shaft, as is of course the case when a central bearing is used. With these small sets, a common spider is used for supporting the stampings of both armature and rotor, while on larger machines the rotor only is carried on a spider, the d.c. stampings being assembled direct on the shaft. The slip-rings only carry current during the period of start, save in three-wire machines, where they have to carry the out-of-balance current. The standard short-circuiting gear which is used to form the star point of the rotor, is of a type which operates direct on the tappings themselves, thus cutting the slip rings out of circuit.

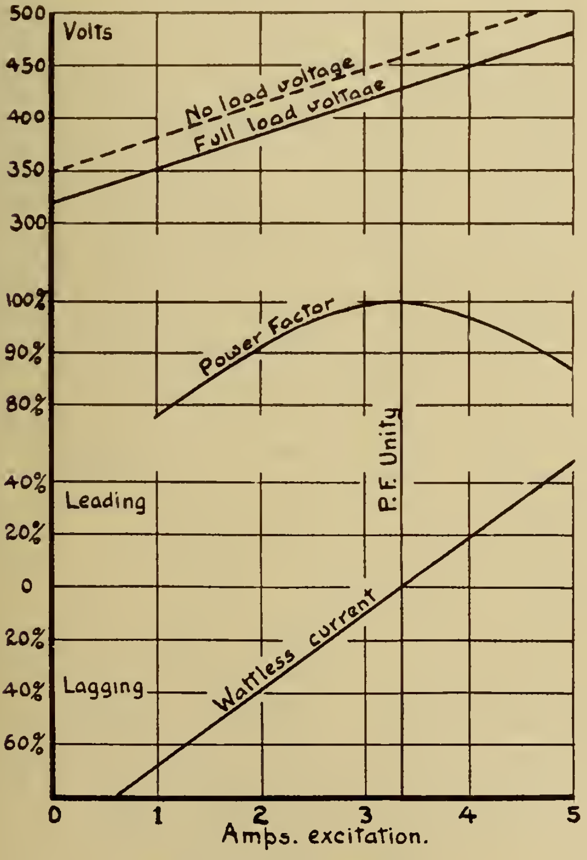


Fig. 4.—Regulation characteristics.

The d.c. field is usually fitted with commutating poles which materially assist the d.c. end to cope with large variations of current without alteration of the brush position. The air gap on the a.c. end is made very much larger than would be the case with an ordinary induction motor, as the primary power factor is not affected by this air gap. The insulation used in the stator is largely mica tubing which is formed under great pressure and heat and makes up into a surprisingly strong mechanical job. In fact these tubes can be machined exactly the same as could be done with fibre, and even better than would be the case when using "Micarta."

In these notes no attempt has been made to draw comparison between the various types of machine which may be used for converting from a.c. to d.c.; it is merely intended to explain the principles of a machine new to the Canadian electrical engineer.

The Automatic Flagman

The Automatic Flagman is a device to protect railway grade-crossings by giving effective warning of the approach of trains. In these days of rapid transit, something more than the old "Stop, Look and Listen" sign is necessary. Such signs are entirely too unobtrusive to attract the attention of the motorist going at 60 miles an hour and at night they are practically worthless. The "Automatic Flagman" however cannot be accused of being too modest. At the approach of a train it rings a loud gong and waves a bright red disc by day and a red lamp by night; so sensitive is the human eye to red and to motion, that such a warning can hardly escape notice. This device consists of a weather-proof case containing the operating mechanism and the signal disc upon which are mounted standard ruby-red switch lenses with an incandescent lamp between. Energy is supplied by a small Westinghouse electric motor which operates the mechanism that rings the gong and waves the disc. The motor receives its energy from storage batteries, lighting circuits, or trolley circuits, depending on the location and character of the installation. On steam roads, the track is insulated and bonded for the desired distance away from the signal and is charged with current from a small battery. The train on entering this block completes the circuit and operates a relay, which connects the motor with the power circuit. When the train leaves the block the circuit is opened and the motor disconnected.

On electric roads, the motor is connected to the trolley circuit by a contactor which is mounted on the trolley wire or third rail and is operated by the car as it passes. A second contactor disconnects the motor when the car passes the signal.

Further Plans for Montreal Underground

The Montreal Electrical Service Commission have applied to the Quebec Public Utilities Commission for sanction to plans for further underground conduits. The plans are: Craig to Notre Dame Streets, and McGill Street to St. Lawrence Boulevard, including Victoria Square, and one side of McGill Street from Notre Dame to William Streets; St. Lawrence Boulevard, from Commissioners Street to Sherbrooke Street; Commissioners Street to Notre Dame Street and McGill Street to St. Lawrence Boulevard; Atwater Avenue from St. Catherine Street to Western Avenue, and on Western Avenue to the city limits linking up with Westmount; also additions to Bleury Street, now under construction, for the fire alarm department and the Montreal, Light, Heat & Power Company. This company, the Tramways Company, and the Montreal Public Service Corporation objected to any further plans being passed on the ground that they could not deal with additional conduit work this year, and the Commission adjourned the application until June 2.

Electricity in the Modern Laundry

A splendid example of the modern electrically driven steam laundry is the New Method Laundry of Toronto.

The laundry proper is of brick construction 150 ft. x 50 ft. with a 10 ft. basement and two 15-foot storeys. Adjacent to the laundry are the stables, garage, repair shops, etc., housed in a two-storey brick building 150 ft. x 30 ft. The two buildings are separated by a 25 ft. wide cement drive roofed over, this latter is used as a shiping yard and is where the delivery waggons are housed for the night.

All machines are electrically driven and in most cases by individual motors. Though most of the ironing is done by steam heat, the smaller apparatus is supplied with electric elements. The equipment follows in detail.

Boiler Room Equipment

Power is supplied by the company's own private plant situated in the basement of the building. The boilers are two Canada Foundry units 150 h.p. each, of the horizontal tubular type. These are hand fed with an average of five tons of coal per day. The coal used is half and half of ¾-in. lump soft coal and hard coal screenings. Live fires are kept up all day maintaining a pressure of 125 lbs. At six o'clock in the evening the fires are banked until after midnight, when the fires are thoroughly cleaned, and at which time the pressure has dropped to about 50 lbs. The fires are then brightened up so as to have full pressure by six o'clock in the morning when the high pressure heating system is turned on. The boilers are equipped with forced draft obtained from a 60-in. Sturtevant fan direct-connected to a small steam engine. This fan supplies an air pressure of 2½ ounces per square inch.

Engine Room Equipment

The engine room equipment consists of two Robb engines 13-in. x 14-in. cylinders with a minimum each of 125 h.p. and a maximum of 160 h.p. These are direct connected to two 75 kw. Crocker-Wheeler Company generators, 125 volts d.c. 600 amperes, 275 r.p.m. These engine-generators are simply duplicate sets, one being held in reserve for emergencies. There is also a small 6 in. x 6 in. auxiliary vertical engine, direct-connected to one 11 kw., 125 volt, Crocker-Wheeler generator. This small generator is used for night lighting, for a large illuminated sign, for elevators, and for ash hoist. The small engine runs from six o'clock in the evening through until morning, utilizing what would otherwise have been waste steam at the end of a day's work, when the fires are banked.

Wiring and Lighting

The wiring distribution throughout the building is a two-wire system in conduit, the switchboard in the engine room being equipped with the usual complement of voltmeter and ammeters. The average day load is 550 amperes at 125 volts rising to 600 amperes during the winter months when the afternoon lighting comes on.

The lighting of the building is of a general character accomplished by 40, 60, and 150 watt tungstens, with enamel steel reflectors and amounts in all to 10 kw. The only special lighting is in the sorting room of the starched goods department where an illumination of approximately six foot-candles is used so as to insure against mistakes in making up the outgoing bundles from the lists.

Steam for Heating and Drying

Steam for heating and drying purposes is brought out from the boilers to a header and reduced to 90 lbs. for high pressure distribution. Separate risers carry this 90 lbs. steam to the various floors, machines and drying rooms. The returns from the high pessure heating come down in eight branches to a receiver. The condensation is taken from the receiver and returned into the boiler through a Moorehead trap.

Low pressure steam for general heating of the building in winter is taken off the header through a separate feeder with a reducing valve which reduces the pressure to 12 lbs. This low pressure heating takes care of the main building and the adjacent stables and residence.

Repair Shop

The engine room is also equipped with a repair shop containing a lathe, drill, and emery wheels where all repairs to machinery and electric equipment is done. This equipment is driven by a 2 h.p. motor.

General Layout of the Laundry

The laundry proper is divided into two general departments: one for household articles, such as table and bed linen known as flats, and the other for wearing apparel, both starched and unstarched. The flats are taken care of on the first floor. The starched goods are laundered on the second floor. The general layout and equipment ot both departments are the same, but there are special features that can best be brought out by following through the routine in each.

Flat Work Department

The packages are brought in by each driver and placed in one of his own bins. Each driver has two bins, one for the Monday collections, and a second one, above the other, for the Tuesday collections. The idea is that no package brought in on Monday and not cleaned out of the bin during that day will become buried under the Tuesday bundles, and not receive preference over the Tuesday collections. The bundles are taken from the bins, opened up, and each article properly marked with the customer's designating number

The clothes first pass to the wash room which has the following equipment: five 100 in. x 40 in. wheels (washers); one 80 in. x 40 in.; two 60 in. x 40 in.; one 40 in. x 40 in. The time the clothes are in the wheels is approximately 75 minutes. From the wheels the clothes are taken to six extractors: one 40-in.; one 36-in.; four 30-in; and then part through two wet tumblers, 40-in. x 48-in. and part through one No. 3 dry-room tumbler, through which air is driven which has been heated by steam coils, 800 ft. of 1¼-in. pipe. Bath towels, bath mats, blankets, etc., are put through the dry room tumbler and receive no further ironing.

All these machines are driven from two line shafts, by one 20 h.p. and one 30 h.p. motor. The 40-in. extractor however is direct connected to a 5 h.p. motor.

The flat ironing room equipment consists of one 120-in. flatwork ironer driven by a 3 h.p. variable speed motor having a 40 per cent. speed variation; one 120-in. No. 4 compound flat-work ironer, driven by a 3 h.p. variable speed motor having 40 per cent. speed variation and one 120-in. 4-roller flat-work ironer for table linen driven by a 2 h.p. variable speed motor with 10 per cent. variation. A special point in the table linen mangle is the fact that it simply irons the linen on one side, thus bringing out the pattern in the weave of the cloth.

From the ironers the pieces are taken to the sorting room which has rows of large pigeon holes into which the clothes are sorted, checked up on the original lists which were brought in by the driver, then taken to the wrapping room where they are finally inspected before wrapping up for delivery.

The goods when wrapped are placed on a motor-driven canvas belt conveyor which carries the packages down to the shipping room where they are sorted out into the bins of the various drivers.

Starched Goods and Flannels

This department is situated on the second floor of the building. The packages as in the case of the flat work are brought in by the drivers to one of their two bins, from which the clothes pass through the marking room, as before, and from there to the wash room.

The equipment of the wash room consists of one 60-in. x 36-in. wheels (washers); two 50-in. x 40-in.; two 48-in. x 40-in.; four 40-in. x 40-in.; two 30-in. x 30-in. Some of these wheels have both cylinder and casing of wood, used for all white goods, and the others wooden wheels with metal casing for flannels and colored goods. The two 30 x 30-in. wheels are for shorts or for goods which show spots after the first washing and are returned for further washing. The goods stay in these wheels approximately 75 minutes. The wringing of the clothes is accomplished by four 30-in. extractors, and one 24-in. extractor which takes about 15 minutes.

All of the above wheels and extractors are driven from two line shafts by two 10 h.p. motors.

One 50 x 36-inch collar tumbler, driven by a motor one-half horsepower, loosens up the mass of collars that come through the washing wheels and separates them for starching.

There are also six 30 x 30-in. porcelain tubes for the hand washing of silk materials, and delicate fabrics.

Starch Department

Three starch boilers of 20-gallon capacity each make up starch of different consistency for shirts, collars and fancy goods respectively. There are three 30-in. x 30-in. porcelain starch tubes for hand dipping. Collars are taken care of by one Bishop collar starcher driven by 1-10 h.p. motor. All dipped starched fancy goods are passed through the beforementioned 24-in extractor for removing surplus starch. There are two cuff and neck band starchers, driven by a 1/8 h.p. motor each, and two bosom starchers. There are also three rubbing down boards, steam heated, on which all wrinkles are rubbed out of shirt bosoms. All the machine starchers are equipped with steam chests supplied with high pressure steam for keeping the starch hot.

Dry Room Equipment

The flannel dry room is 10 x 10 x 8-ft., the temperature is maintained at 60 deg. by means of 675 feet of 1-in. piping arranged around three sides of the room. At the top of the room is a fan driven by a 1-5 h.p. motor for producing air circulation. Flannels remain in this room approximately 20 minutes. All socks and stockings are dried on wire frames which have an adjustable heel. This method of drying is not necessarily to prevent shrinking but to preserve the shape of the stocking.

The fancy work dry room is 10 x 10 x 8-ft., the temperature of which is maintained at 258 deg. by means of 850 feet of 1in. piping installed around three sides of the room as a steam coil. The wash pieces are carried suspended from an endless chain conveyor, having 5 loops inside of the dry room with a double length of approximately 100 feet of travel. It takes 19 minutes for a garment to pass through a dry room. The clips which fasten a garment to the travelling chain are automatically opened as they pass out of the dry room allowing the garment to drop into waiting baskets. There are two of these hooks every six inches on the chain.

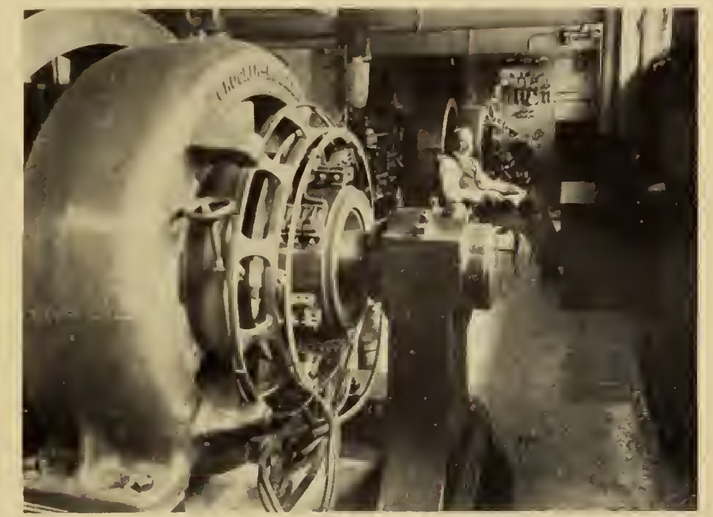
The collar dry room is 10 x 10 x 8-ft., steam heated to a temperature of 258 deg. by means of 750 feet of 1-in. piping in coils and equipped with a 5-loop travelling chain driven at a speed which will keep a collar in the dry room for 30 minutes. These collars also drop off automatically as they emerge from the room, on to a table.

The shirt dry room is 10 x 20 x 8-ft. with a partition in the center and is maintained at 258 deg. by means of 1,007 feet of 1-in. piping arranged in coils around three sides and on the partition. This room is equipped with a travelling carrier of 10 loops, the fifth loop coming out of the dry room to enable the shirts to air. The speed of the traveller is such that the shirts take 19 minutes to travel the full distance.

The fancy work, collars and shirt dry rooms are ventilated by means of overhead fans, which, together with the travelling carriers are driven by two 1 h.p. motors.

Curtain Dry Room

This room consists of what might be described as a large box opened at the top, 14 x 14 x 8-ft. and with a platform around the upper part. At the top of this box room on the inside is swung horizontally a large cylinder one-third of which completely fills up the opening in the top of the room. The cylinder is covered with felt and an outer covering of ruled canvas. Curtains are stretched on this cylinder frame, the rulings on the canvas enabling the curtains to be kept straight. The curtains are held down by long pins and in case of scollops each scollop is pinned. As soon as a curtain has been stretched the cylinder is given a one-third revolution turning the curtain side down into the dry room and presenting a fresh side of the cylinder at the top. Another curtain is now placed as before, and then turned down presenting the third section of the cylinder for the placing of another curtain. By the time this third curtain has been placed and the cylinder turned the first curtain which then appears is thoroughly dried. The temperature of this curtain drier is maintained at 200 deg. by means of 300 feet of 1¼-in. piping arranged in coils near the floor of the room, and in planes normal to the cylinder.



View of generator room—New Method Laundry.

Ironing Department

Shirts—The shirts are brought from the dry room, dampened by a shirt dampener, motor-driven by a 2-5 h.p. motor and passed to four cuff presses and four neck band and yoke presses which are foot operated and steam heated. Thence to four double bosom presses, shaft driven by a ¾ h.p. motor and all steam heated. These bosom presses have two bosom boards so arranged that one can be swung out to receive a shirt while the first one is under the press. The shirts now pass to four body ironers and to four sleeve ironers all shaft driven by two 1 h.p. motors. The body ironers are equipped with 4 kw. electric elements and the sleeve ironers with heating elements taking approximately 1 1-3 kw. The shirts are now ready for the hand finishers of which there are five using 600 watt 4 lb. electric hand irons. The finishers iron out any stray wrinkles, fold the shirts and pass them on to the inspection table where they are inspected and an inspection slip put with each shirt. Each shirt is placed on a sheet of cardboard which has a sheet of tissue paper fastened to one edge of it, this paper is wrapped around the shirt protecting it from soil. The next move is to the sorting room where the shirt awaits the other pieces which came with it.

Collars—All collars are dampened in a machine dampener driven by a 1-5 h.p. motor, and then run through a 60-in. steam collar-ironer (1 h.p. motor). All collars pass to the collar table and are then shaped and have their edges and ends ironed by gas heated Art-edgers and end-ironers. Turnover collars are run through a seam dampener so that they can be bent without breaking the fabric, then moulded in a steam heated collar moulder and the top edge of collar ironed with an electrically-heated 600 watt shaper. Collars with turned-back tips have their tips steamed in a tip moistener and are pressed in a steam-heated tip bender, the two tips being ironed at the same time. All machines on the collar table are shaft driven by a 1 h.p. motor. All collars are inspected and damp bubbles or wrinkles are taken out on a foot power, steam-heated collar press. Down through the inspection table passes an enamel-lined steam coil jacketed tube 4-in. in diameter and about 24-in. long. As each collar passes inspection it is rolled up and placed in this tube and is forced down through into a waiting basket by the succeeding collars. The collars are in this tube for about two minutes and are thoroughly dried. From the collar table the collars are taken to the sorting room and each lot put in a narrow band of cardboard for delivery.

Flannels—Flannels after leaving the dry room are placed on a steaming table and carded with a whisk broom. There are 10 ironers, using 600 watt, 6 lb. and 750 watt, 8 lb. electric hand irons, on common ironing.

Fancy Work—Fancy work such as ladies' waists and underwear are all hand ironed by 11 electric 750 watt 8 lb. hand irons. There is also a steam-heated fluting iron and steam-heated balls of various shapes to press the shoulder and elbow puffs of ladies' waists.

The ironing boards for flannel and fancy ironing are placed in two rows and between them runs an endless conveyor chain with clips to which each operator attaches a garment as soon as finished. This conveyor passes down to the inspection table where all articles are inspected, mended (¼ h.p. sewing machine being used) and passed to the sorting room where each order is collected and wrapped together with the accompanying shirts and collars.

The bundles, each with its original list, are carried to the ground floor on a canvas belt conveyor to the shipping room where they are sorted into the various outgoing bins for the various drivers.

The equipment is so laid out on the two floors that the goods never retrace their steps. They pass continually forward from the washing wheels to the sorting room. Where it is not possible for one department to actually hand the goods over to the next there are mechanical conveyors or messenger girls so that no operator has to leave her machine.

Water and Soap—In a pent house above the top floor are located the soap kettles, bleach vats and hot and cold water tanks. Four hundred pounds of chipped soap are melted down twice a week making a total of 6,000 gallons of liquid soap per week. This soap is liquified and neutralized in a rectangular tank of 600 cubic feet capacity. One end of this tank is partitioned off for a reserve supply of soap which is used while a new batch is being made. The soap is piped down to the two wash rooms. The main water tank receives water from the city mains and filters it through a sand and canvas filter. The hot water tank contains 5,000 gallons and is heated by means of Hoppes feed water heater utilizing the exhaust steam of the engine. This hot water tank also contains a filter composed of coke, excelsior and canvas and is equipped with a motor-driven centrifugal circulating pump which circulates the hot water through the heater and filter bringing the water up to about 160 deg. F. There are 1,250,000 gallons of water used per month.

The 19 delivery wagons collect the work on Monday and Tuesday. Each driver received a bundle of lists covering his route, these are delivered to him in the order in which he will call for his work and each list has the customer's name, address, mark, and route number marked (addressograph) on it. As he goes to each customer he places the proper list in each bundle he receives. Customers are requested to separate flat work from starched work and the driver will find each week proper lists for each customer in his package of lists. The drivers in the outlying districts are met during the day by the motor truck at stated points and relieved of their load.

Appreciation is made for the courtesies extended by Mr. J. J. Sheedy, general manager, and Mr. H. W. Smith, engineer in charge.

Summary of Equipment With Uses

2	150 h.p.	Boilers	Horizontal tubular, 125 lbs. pressure
1	60 h.p.	Fan (draught)	4½ oz. air pressure per sq. in.
1	15 h.p.	Engine	Fan
1	4 h.p.	Motor	Ash hoist
2	160 h.p.	Engines	13-in. x 14-in., 275 r.p.m.
1	15 h.p.	Engine	6-in. x 6-in. 550 r.p.m., vertical
2	75 kw.	Generators	d.c., 125 v., 600 a., 275 r.p.m.
1	11 kw.	Generator	d.c., 125 v., 90 a., 550 r.p.m.
1	10 h.p.	Motor	Passenger & freight elevator
1	2 h.p.	Motor	Machine repair shop
1	2/5 h.p.	Motor	Tagging and sewing machines (on shaft)
1	20 h.p.	Motor	Driving shaft for flat work machines
1	30 h.p.	Motor	Driving shaft for flat work machines
1	5 h.p.	Motor	Hydro-extractor
1	3 h.p.	Motor	Cylinder calender
1	3 h.p.	Motor	Compound ironer
1	2 h.p.	Motor	Ironer
2	10 h.p.	Motors	Shafts for washers and extractors
1	½ h.p.	Motor	Collar tumbler.
1	1/10 h.p.	Motor	Collar starcher
2	1/8 h.p.	Motors	Cuff and neck band starchers
1	1/5 h.p.	Motor	Circulating fan in dry room
2	1 h.p.	Motors	Conveyors for dry rooms
1	1/5 h.p.	Motor	Collar dampener
1	2/5 h.p.	Motor	Shirt dampener
1	¾ h.p.	Motor	Double bosom press
2	1 h.p.	Motors	Body and sleeve ironers
1	2 h.p.	Motor	Mangle
1	1 h.p.	Motor	Collar mangle
4	1 1/3 kw.	Irons	Sleeves
4	4 kw.	Irons	Body Ironers
5	600 w.	Irons	4 lb.
21	600 & 750 w.	Irons	6 lb. and 8 lb.
1	2/5 h.p.	Motor	Chain Conveyor
1	600 w.	Iron	Collar shaper
1	1 h.p.	Motor	Shaft driving machines on collar table
1	1/4 h.p.	Motor	Sewing machines
1	1 h.p.	Motor	Belt conveyor
1	5 h.p.	Motor	Circulating pump
1	5 h.p.	Motor	Grinding feed.

Electric Railways

Increase in B. C. E. R. Rates Sustained

The adoption by the Vancouver board of trade of the majority report of the special committee appointed to investigate street car fares as levied by the British Columbia Electric Railway Company, Limited, is a vindication of the company's action last September in proclaiming a straight five cent rate. Considerable interest has been caused throughout Canada by the investigation and the result has been awaited with much interest by the various electrical transportation concerns which may contemplate a similar policy in regard to street car fares. Following is the complete majority report:

Mr. President, and members of the board of trade,—Gentlemen:—Your committee appointed to investigate the matter of the recent increase in fares by the B. C. Electric Railway Company in the city of Vancouver in September last, herewith beg to set out its report:

We feel that any findings this board makes should be based on a fair analysis of conditions, as to the cost of labor, cost of material, and any other exigencies which enter into the development, equipment and maintenance of a passenger carrying system, such as that provided by the B. C. Electric Railway Company.

Your committee has held ten meetings and has obtained information with respect to the cost of fares and areas served by such fares, from Montreal, Toronto, Winnipeg, Edmonton, Calgary, Seattle, Portland, San Francisco and Los Angeles. We have also obtained a great deal of information from officers of the B. C. Electric Railway Company, who have invariably treated the committee with courtesy.

Our finding is that the B. C. Electric Railway Company was, under existing conditions, justified in raising its fares, but that as soon as the present high proportion of expense to earnings can be reduced, a reconsideration of the fares charged will be justifiable. We submit the following as some of the reasons for our finding:

The money actually expended up to June 30, 1913, amounted to $45,168,312, and the amount paid out in interest and dividends for the year amounted to $1,888,139, equal to 4.18 per cent. on the entire investment.

That during the last ten years the cost of equipment, supplies and wages has increased at least 25 per cent. The wages paid by the B. C. Electric Railway Company are about 10 per cent. higher than those paid in any other Pacific coast city, and from 20 to 25 per cent. higher than those paid in the cities of Eastern Canada.

Conductors and motormen on the company's system receive 27 cents per hour for the first year, increasing to 36½ cents per hour in the fifth year, while Seattle pays 25 cents per hour the first year, increasing to 32 cents in fifteen years; Portland pays 25 cents per hour for first year, increasing to 31 cents per hour in the sixth year; San Francisco pays 25 cents per hour the first year, increasing to 33 cents per hour in the ninth year; Los Angeles pays 25 cents per hour the first year; increasing to 30 cents in five years; Montreal pays 23 cents per hour the first year, increasing to 25 cents per hour the third year and thereafter; Toronto pays 23½ cents per hour the first year, increasing to 27½ cents the third year and thereafter; Winnipeg pays 25 cents per hour the first year, increasing to 34 cents in the fourth year.

A similar comparison of the wages paid to trackmen, barnmen and mechanics, shows a corresponding increase paid by the B. C. Electric Railway Company as compared with the above mentioned cities.

There are about 800 conductors and motormen employed in Vancouver and on the suburban lines, working an average of nine hours per day. These men receive 18 cents more per day than paid in any other coast city. This amounts to $52,560 in a year, and if we include the trackmen, barnmen and mechanics the amount would be more than doubled. Again, equipment and supplies are about 15 per cent. higher in Vancouver than in other coast cities, and 10 per cent. higher than in Eastern Canadian cities.

For example, a car costing $7,407.80 at Vancouver can be purchased in Seattle for $5,986.40, and in Toronto for $6,522.25. With respect to operating expenses the Electric Railway Journal of October 25, 1913, shows the operating expense ratios of forty of the leading electric railway systems of this continent. The average is 59.09 per cent., and the B. C. Electric Railway Company has the highest ratio, amounting to 75.03 per cent. The figures given relate only to straight operating expenses and do not include any charge for renewals, depreciation, taxes or accident reserve.

It has been put forward in a criticism of the B. C. Electric Railway Company that other companies serve a greater area for the same fare than that railway, but we have considered that the area served by any railway is no indication of the service rendered to the public without taking into consideration the population, track mileage, and number of cars operated within that area. The North Vancouver service with nearly ten miles of trackage and a population of about 8,000 covers an area almost as large as the city of Vancouver with a population of 120,000 people, and seventy miles of trackage.

Another argument has been advanced in some quarters that owing to the policy of the company of contesting so many accident claims in court the expenses in connection with this department have been excessive. This statement has not been borne out by the facts as the following figures will show: The total number of accident cases dealt with by the B. C. Electric Railway Company from January 1, 1911, to February 20, 1914, was 1,420. Of these 66 were contested in court and 1,354 amicably settled without reference to law. This shows an average contested of less than 5 per cent.

We asked the company to state to the committee the cost of power charged them and were informed that they could not answer specifically as to the charge per horse-power or kw. hour, but submitted the following table showing the cost per car mile for the year ending June 30, 1913, as compared with the cost on other systems in Canada:

Cost of power per car-mile.	Cents
B. C. Electric Railway	2.98

Montreal	2.62
Toronto	2.58
Winnipeg	2.81
Edmonton	11.22
Calgary	5.23

The revenue per car mile for four of the leading electric railway systems of Canada in 1912 shows Vancouver the least remunerative in that regard. Toronto provided $42,846 per car mile; Montreal $30,259; Winnipeg $23,230, and Vancouver $22,038.

We find further that with few exceptions the usual fare charged in the principal cities of the United States is 5 cents. In Canada the fare is usually about the same as that charged by the B. C. Electric Railway Company previous to September last. The straight 5-cent fare is charged in nearly all the Pacific coast cities, including Seattle, San Francisco and Los Angeles. In Portland the fare is 5 cents or 50 tickets for $2.25.

To the best of our knowledge the B. C. Electric Railway Company is the only company on the Pacific coast selling workingmen's tickets at 4 cents. These are issued in ten tickets for 40 cents, five white and five green, the white tickets being good from 5 a.m. to 8 a.m. and the green are good at all hours.

A good deal has been said about the distance that passengers are carried in other cities for one fare as compared with Vancouver. We think there is not much to complain of in this respect, as city passengers can travel from Alma road and Tenth avenue to Hastings street and Boundary avenue, a distance of 8.35 miles, and settlers are carried from Dunbar street and Wilson road to Hastings street and Boundary avenue, a distance of 11.78 miles for 5 cents.

Notwithstanding the fact that the number of passengers carried has been steadily falling off from June last, the company is giving better service than ever, the number of car miles at present averaging about 90,000 per year more than in 1912.

The growth of traffic in years previous to 1913 warranted liberal outlays in development and equipment, and consequent on these outlays the operating expenses increased very considerably. In 1908 the rate of operating expenses of the railway department, exclusive of interest on outlay, was 71.09 per cent. of gross earnings; this ratio increased to 91 per cent. in 1913. In 1913 the gross earnings were three and one-half times as much as in 1908, but the net earnings were the same as in 1908, notwithstanding the fact as stated by the company that three times the amount of capital was employed in 1913 as compared with 1908.

The total capital invested by the company has increased by about $6,000,000 annually for the last five years, and now totals about $45,000,000. Your committee has taken into consideration that the securing of capital for such undertakings as this is naturally dependent upon a fair return on the investment.

The conditions which we find justify the increase in fares, call for and have resulted in strict economy in expenses and management, and it may be reasonably expected that in time these economies will reduce the present high proportion of operating expenses sufficiently to warrant a reconsideration of fares charged, but such reductions cannot be expected to greatly influence return on invested capital until passenger traffic increases.

Hull Fares Upheld

The application of Mayor Baillie, of Aylmer, made to the Railway Commission, on behalf of the town of Aylmer on Tuesday, May 19th, for a reduction of the fare between the city of Hull and Aylmer on the Hull Electric Railway, was dismissed by the Board after each side had been heard briefly. Mayor Baillie told the board that there are 400 people in Aylmer who work in Ottawa all the year round and that the number would be increased if the fares on the Hull Electric were reduced. Mr. E. W. Beatty, representing the company submitted facts and figures showing that the fares per mile on the Hull Electric are lower than on many other similar roads in Canada and the United States; he also explained that the company only pays a dividend of 3.7 per cent. Mr. Gordon Gale, general manager for the company, stated that one car with about 50 government employees came into Ottawa every day, and he took issue with Mayor Baillie's statement that 400 people travelled daily into the capital from Aylmer.

Chairman Drayton decided that as the company's earnings were comparatively small the application would have to be dismissed.

Solid and Insert Manganese Special Track Work

In the city of Chicago during the last eight years exhaustive tests under the direction of the Board of Supervising Engineers have been carried out on solid and insert manganese steel as applied to track work. The current issue of the Electric Railway Journal prints the history and results of this work, the latter of which are of extreme value. We print extracts of the report below.

In probably no other city has manganese steel special work received more thorough and exhaustive test than on the surface lines of Chicago. Experience with the three types of special work, namely, solid manganese, cast-iron bound manganese insert, and cast-steel manganese insert, began in 1908. Since that time more than 1,000 installations including more than 10,000 pieces, have been laid down. This large number of installations, as well as the wide divergence in the character of traffic, namely, from a density of a few seconds' headway in the downtown district to several minutes' headway as found on outlying cross-town lines, makes this test exhaustive in scope and convincing in results. Moreover, installations were furnished by practically all of the large manganese track special work manufacturers in this country; consequently it should be representative of what may be expected of various designs of this material as installed in Chicago. Experience there under all classes of traffic has demonstrated clearly the advantages and disadvantages of the different types in a much shorter time than could be possible in any other city where the traffic is lighter.

It may be well first to consider the conditions under which this manganese special work was purchased. In 1907 and 1908 ordinances were passed granting franchises to the four surface railways operating within the corporate limits of Chicago. Among other things they provided for a comprehensive reconstruction of all the tracks inside the city. This work was done under the direction of the Board of Supervising Engineers. In the board's endeavor to make the rehabilitated work as permanent as possible, it thoroughly investigated many of the different types of track construction and track materials in general use at that time and consulted with the manufacturers. Specifications under which the manufacturers were willing to bid with a three-year guarantee were then adopted. The specifications issued at that time for the manufacture of track special work were the first general specifications for that kind of material to be prepared by anyone.

The clauses in the ordinances which referred to special work merely required that at all track intersections suitable steel special work of ample strength and weight, to correspond with the structure to which it connected, should be provided and that frogs, switches and mates should be furnished with wearing plates of hardened steel. Investigation by the board developed the fact that special work manufactured of hardened steel or manganese steel designed to withstand extraordinary wear could be purchased with a three-year guarantee. This made it desirable from an economy standpoint, and at that time it was believed that solid manganese would give a maximum wearing life at the minimum cost of operation. It should be noted, however, that the guarantee clause was eliminated from the specifications about February, 1910.

Special Work Specifications

The specifications governing the manufacture of track special work were made to cover four types, namely, A, B, C and D, and each type was specified in 7-in. and 9-in. rail depths. Type A was made with a solid-steel casting for running rails, with manganese steel plates inserted at the wear points. Type B was made of solid manganese castings, arranged to fish with abutting rails. Type C was a cast-steel bound or cast-iron bound construction, using standard Chicago rail with manganese steel plates inserted at the points of greatest wear. Type D was ordinary built-up track special work composed of rolled Chicago rail sections and mechanical joints. Other portions of these specifications provided for over-all dimensions, tolerances, drilling and inspection.

All special work was built to a gauge of 4 ft. 8½ in. on straight track and on curves having a radius greater than 80 ft. On curves sharper than an 80-ft. radius, the gauge was increased ¼ in. In all special work, however, a maximum variation of ⅛ in. greater than standard gauge was allowed. All switches, mates and frogs were designed for 3½-in. wheel-tread clearance, a 1 3/16-in. throat and a tongue throw of 1¼ in. All exterior frog arms were required to be of sufficient length to permit easy access for placing the joint plates. In all cases it was required that the over-all length should not be greater than these specified dimensions or more than ⅛ in. less than the same. Ninety-degree crossing frogs were considered in a separate class, and the exterior arms were required to be of a length equal to one-half the distance between the gauge lines of the inside rails of parallel tracks, with an allowance of 1/16 in. for joints. The object of these limit dimensions in 90-deg. crossings was to make them interchangeable.

At the time the special work specifications were adopted there was considerable discussion among the members of the board as to the proper depth of groove. It was agreed that the shallow groove would tend to reduce noise. After a discussion of the various types, it was finally decided that all points involved could best be served by making the groove depth 11/16 in. It was thought that this depth would provide entire safety for the passage of cars and at the same time reduce noise, or at least that it would determine the effect of depth of groove upon the elimination of noise at crossings. This was in 1909, and since that time the 11/16-in. depth has remained the standard.

Some time during 1906 the 129-lb. Chicago girder-grooved rail section was adopted. The specifications for the manufacture of this rail were drawn in such a way as to provide rails that would give a maximum wearing life under heavy street railway service.

The specification did not call for any particular chemical composition in the manganese steel used in the solid and insert track special work, it being left to the manufacturers to furnish material that would meet the three-year guarantee. In 1909, however, after considerable solid manganese work had been installed, it was thought desirable to obtain information as to the character of manganese steel placed in the track special work. Accordingly, a number of switch tongues were purchased from the manufacturers supplying the special work for Chicago, and these pieces were tested for physical characteristics by a firm of inspecting engineers.

The tests to which the manganese switch points were subjected were of three kinds, namely, drill tests, ball impression tests and transverse bending tests. In the first tests, the drill was used for a period of two minutes, then resharpened, and the operation repeated four times. It was found that all of the samples were practically undrillable. The depth of the holes, after the completion of the tests, were measured to the nearest 0.001 in., and the average for the three was 0.0327 in.

In the ball impression test a steel ball 7/16 in. in diameter was set on the faces of the three tongue-switch specimens and subjected to a load of 35,000 lb. Upon removal the diameter of the impression in the surface of the manganese tongue was measured, and in each case it was found to be 0.32 in. This indicated that the surface hardness averaged approximately the same in the three sample switch tongues tested.

In the transverse bending tests of manganese tongue switches, great care was exercised in applying the load to the three samples so that the test conditions for each might be the same. Each tongue was laid on supports exactly 3 ft apart, and the load was applied at the lug, the tongue resting on these supports in an inverted position. In each case it was found that the elastic limit was reached when the load was approximately 14,000 lb.

Chemical Analysis of Three Manganese Tongues, Chicago

	"A" per cent.	"B" per cent.	"C" per cent.
Carbon (combustion) ...	1.100	1.260	1.240
Carbon (color)	1.010	1.150	1.190
Silicon	0.470	0.260	0.350
Manganese	11.440	10.880	12.480
Manganese (check)	11.280	10.960	12.560
Phosphorous	0.067	0.056	0.084
Sulphur	0.021	0.036	0.033
Copper	None	0.340	0.090

In addition to the physical tests a chemical analysis was made of three sample tongues by two representative analytical chemists. While there was some variation in the results of the chemical analyses made by the two chemists, the relative proportions of the constituent elements in the three samples were approximately the same.

As an additional precaution in the board's endeavor to secure special work pieces equal to the specification and containing no mechanical defects, all work was inspected at the point of manufacture. Besides the inspection for correct dimensions, evidences of cold shot, fractures or segregation of the metal in the head or wearing part of any special-work casting were considered sufficient cause for rejection. Other fractures or cracks appearing in the base of the casting which, in the judgment of the inspector, did not extend into the web or strain a bearing part of the casting, sufficiently to impair its usefulness, were not considered causes for rejection.

Cracks were permitted in the web of the rail at the end, provided they did not extend beyond the first bolt hole in either the upper or lower row. Cracks in the end of the web of the rail which did not terminate in the bolt holes were considered sufficient cause to reject a piece, provided these cracks extended more than 1½ in. in from the end of the rail. Fractures or cracks in switch pieces near the box which did not affect the strength of the switch piece, in the judgment of the inspector, did not cause rejection of the piece.

In practically all cases the method of installing track special work in Chicago has been the same. This includes an 8-in. crushed-stone ballast foundation, 7-in. x 9-in. white oak ties on 2-ft. centers, cut to special lengths to fit each crossing. In most instances it was impossible to roll the crushed-stone foundation under these crossings because intersecting traffic could not be interrupted. This made it necessary to leave out the paving for a certain period so that the crossing could be retamped repeatedly until a thoroughly compact bearing was secured. The character of foundation has not been the cause of crossing failures except in a very few instances. In fact, the failures at points where the foundation has given way are no worse than those where the foundation has stood up. All complicated crossings were purchased built of several pieces so that renewals could be made by replacing only the failed or worn-out portions. Simple right-angle intersections as a rule were purchased in a solid piece for each track crossing. In order to allow for expansion and contraction as well as to preserve the temper of solid manganese special work, all connections were made with mechanical joints.

Solid Manganese Steel Service Results

A most careful and impartial inspection of a great number of special-work installations shows all too plainly what effect traffic has had on the three types of special work used in Chicago. With the possible exception of switches and mates, it is said that more than 50 per cent. of the solid manganese pieces have failed before the end of the three-year guarantee. Those remaining were in excellent condition at the time of inspection and represent what was expected of the solid manganese when it was adopted for track special work.

Inspections beginning in 1908, soon after the first pieces were installed, and continued to date, show that the solid manganese began to fail by "chipping" at the wear-points soon after the first year. The number of points chipped, however, reached a maximum at the end of two and one-half years regardless of the density of traffic, and in many instances renewals were necessary to provide safe operation. The character of the chipping in most instances was much the same and indicated that the piece was improperly tempered, or that there was a segregation of the metal at the points of failure. In practically all cases, as might be expected, the first pieces were broken from the receiving rail corners. Usually the broken piece took the form of a triangular prism which feathered out in the ball of the running rails and was thickest at the point of intersecting flangeways. One explanation of the failure is that it was the termination of life due to the low elastic limit of the material. According to this explanation the comparatively small area receiving the blow from the narrow tread wheels is stretched and pulled beyond the elastic limit of the material, the great tenacity of the material preventing rupture until the material finally parts in prismatic portions as described. In this respect, the effect differs from chipping which occurs from too hard material with high elastic limit and ultimate strength not much larger than the elastic limit.

Another class of failure in the solid-manganese crossings took the form of cupping or cold rolling. As in the case of "chipping" no definite rule could be drawn, because pieces failed both ways, again indicating that the tempering process or the inherent qualities of the metal made it unsuitable to withstand repeated impact blows. The cupping or cold rolling usually followed the chipping, and in no case was it confined to the intersecting flangeways but was quite evident the full length of the manganese running rails. Some of the solid manganese right-angle crossings were bought in one piece and some in halves. At the present time the tendency among the manufacturers is not to supply the crossing in one piece, in the belief that this plan is not conducive to long life.

One of the most prominent evidences of cold rolling was found where dense traffic moves over one line and little or no traffic passes over the intersecting line. In many instances the metal has flowed until the intersecting flangeway is practically closed where it crosses the heavy traffic running rail. In other instances the effect of cold rolling is to flatten the ball of the manganese rail. This may be noted in the illustrations, where the tread-wear area on manganese rail is apparently much wider than on the standard Chicago rail. This effect was also quite marked at the points where the standard unbroken main-line frogs were installed in which the floor of the throatway is level with the unbroken main-line running rail. Where traffic was heavy on the main line, as much as ½-in. wear, resulting in this difference in the elevation of the top of the main-line running rail and the branch-off throatway-floor, was noted in several instances.

In connection with the cold rolling or cupping it may be of interest to note that in most instances the metal flows to both sides of the ball of the rail. That flowing to the flangeway side is sheared off by the wheel flanges, and that on the opposite side forms a lip over the lower portion of the ball similar to low-carbon steel rails under heavy traffic. It may also be of interest to state that the cupping does not appear to depend on the character of support. To substantiate this, the cupping at joints represents the supported form over a single web. That in acute angle flangeway intersections was where the points receiving greatest impact were suspended between two web supports. The 90-deg. crossings usually have one supported and one suspended point of impact. As a general rule it might be stated, however, that chipping predominates in the 90-deg. intersections and cupping at the acute-angle intersections.

Cupping at the manganese receiving rail is found invariably, but it is seldom at the run-off from the manganese to the Chicago rail. In angle crossings of switch pieces cupping in one manganese rail also reflects a cup in the opposite rail. Cupping takes place regardless of the condition of the joint, and in many instances it was found most prominent where there was no appreciable difference in the elevation of the two butting rails. In other cases where there was considerable offset and the receiving rail was the Chicago section, the cupping was slight.

The tests made on the sample switch tongues indicated that the best quality of manganese steel for track work was its ability to resist abrasion. In order to check this a number of points were inspected, and invariably the result was the same, namely, there was no appreciable difference between this quality of manganese steel and that of the Chicago rail. The slow movement of traffic around the curves caused the running rail to wear and show the effect of cold rolling to a far greater degree than the abrasive wear on the guard. For this reason it is believed that renewals will have to be made for running-rail wear rather than for guard-rail wear.

Service Results of Manganese Insert Special Work

A similar study of cast-steel and iron-bound renewable manganese insert special work under the various classes of traffic and for various life periods was made. While the inspections indicated that the manganese inserts failed by chipping there was little or no evidence of cold rolling. These inspections also indicated that the chipping of inserts began after the first year in most instances but was the worst after two and one-half years' service. Again this appears to be a problem in tempering, but the failures of inserts are fewer, and, on the other hand, many of the faulty inserts may be renewed without any disturbance to the pavement. In contrast with the solid manganese special work, however very little evidence of cold rolling or cupping was found in the cast steel or Chicago rail arms in the crossing frogs. In fact, many insert pieces were inspected which had been under more severe traffic conditions than the solid manganese, yet the common forms of failure in the latter were not found.

Experience with renewable insert special work in Chicago demonstrates that it is possible to maintain some forms tight in the spelter bed. Although some of these renewable inserts have become loose, a few probably because they were improperly set and fastened by the manufacturers, others indicate that the manner of fastening was not of sufficient mechanical strength to withstand the severe impact blows. As a rule inspections tended to bring out the fact that most loose inserts occurred at the 90-deg. crossings and that at angles of less than 90 deg. intersection the loose inserts were seldom found. When these renewable insert pieces did not fail mechanically and were under very heavy traffic, the service results were far superior to solid manganese. This is shown in some of the illustrations. It was also found that, as a rule, cast-steel arms with manganese inserts stood up better under all classes of traffic than the cast-steel or cast-iron bound frogs. In the cast-steel arm type, however, the same problem arose at times as with manganese steel, namely, there was a lack of uniformity in the quality of the cast-steel furnished by the same or different manufacturers. The cupping and cold rolling are also held to be evidences of the quality of the material mentioned in the previous paragraph.

Manganese Switches and Mates

The Chicago standard switches and mates, generally speaking, have stood up better than the frogs and crossings, yet under heavy traffic cupping at the receiving end of the manganese piece, as well as at the heel of the tongue, was quite pronounced. Where traffic was heavy through the branch-off, the tongue indicates unusual wearing qualities. Where traffic was heavy along the straight track, cupping and cold rolling throughout the manganese piece was quite evident.

Repairing Manganese Steel With Electric Welder

Another point which may be of interest in connection with solid manganese is the experience accompanying attempts to repair it by electric welding. Tests have been made to build up broken points and cupped joints in solid manganese steel special work in some cases with satisfactory results, though in some others with failures. Here again the peculiar characteristics of the metal make difficult the process of repair with an electric welder. With manganese alloy in steel the usual tempering process has to be reversed, that is to say, gradual cooling makes a casting hard and brittle. Consequently as the piece comes from the mold it is hard and brittle and the heating or annealing process is followed by quenching which brings about the desired toughness. During the process of welding new metal onto broken points in manganese steel special work, a portion of the old manganese casting becomes heated to a welding temperature. This results in a hardening of a portion of the old casting, which in many cases becomes quite brittle, and new breaks occur. Undoubtedly the reason for the success of welds of this kind in those cases where it has proved successful is that the portion of the old casting heated was confined to a very small area. It may be possible to overcome this difficulty, but even under present conditions 50 per cent. of the castings thus repaired have stood up under service for a time, and as the cost of making the repair is small the use of the welding outfit seems worth while.

Typical Failures of Manganese Steel

An examination of the solid manganese failures under varying traffic conditions brought out the fact that cupping and cold rolling predominated. It may be stated generally that the Chicago rail laid on various types of foundations has developed little or no cupping up to the present time. There are a number of instances where rail corrugation has developed, but this may be attributed to causes other than that bringing about cupping at the rail joints. On the other hand, cupping and cold rolling were largely confined to the manganese steel special work and especially in the solid manganese. Almost invariably where the manganese steel piece was the receiving rail, cupping developed regardless of the density of traffic or the condition of the joint.

In order that accurate comparisons could be made of the various special work installations, it was necessary to reduce the traffic and tonnage over each point discussed to a unit basis. This was accomplished by computing the total number of cars in all directions, passing over a particular crossing in a twenty-four-hour week-day and a twenty-four-hour Sunday. From these the average number of cars per hour and then the average number of wheels were computed, four wheels being taken for each double-track car as the number passing over any given point. To arrive at the unit tonnage figure, it was estimated that the average double-truck car in Chicago weighed 50,000 lb. and that the average passenger load was 10,000 lb. This total, or 60,000 lb., was divided by eight for the unit load per wheel and was multiplied by the number of wheels passing over a given point per hour.

Canadian Electric Railway Association Convention

The Canadian Electric Railway Association held their annual convention at the Chateau Laurier, Ottawa, May 13 and 14. At the closing session Mr. C. B. King, manager of the London Street Railway, was elected president for the ensuing year. The other officers are: J. D. Fraser, vice-president; executive committee: E. P. Coleman, general manager Dominion Power and Transmission Company, Hamilton; A. Eastman, vice-president and general manager Windsor, Essex and Lake Shore Rapid Railway, Kingsville; H. M. Hopper, general manager St. John Street Railway; Wilson Phillips, superintendent Winnipeg Electric Railway; C. L. Wilson, assistant manager Toronto and York Radial Railway; Patrick Dubee, secretary-treasurer Montreal Tramways Company, retiring president, member of the executive committee ex-officio.

During the convention the following papers were read· Steel Car Construction, J. A. Wilson, Superintendent Car Department, Ottawa Car Manufacturing Company; The Diesel Crude Oil Engine as Applied to Street Railway Operation, A. H. Dion, Superintendent, Moose Jaw Street Railway; Prevention of Accidents, A. E. Beck, Claims Solicitor, British Columbia Electric Railway; Floral Work at Railway Stations, E. T. Cook, F.R.H.S., author of Gardens of England, etc.; Recent Improvements in Electric Car Equipment, W. G. Gordon, Transportation Engineer, Canadian General Electric Company; A Few Disconnected Ideas on Street Railway Operation, F. D. Burpee, Superintendent, Ottawa Electric Railway; Construction Accounting, E. P. Coleman, General Manager, Dominion Power and Transmission Company, Hamilton; Loyalty in Electric Railway Work, A. M. Smith, Master Mechanic, Toronto and York Radial Railway.

On the evening of Wednesday the 25th, the delegates were entertained at dinner at the Royal Ottawa Golf Club, by the Ottawa Electric Railway Company. At this function Mr. Thomas Ahearn, president of the company, presided, and Mr. Warren Y. Soper, vice-president of the O. E. R., entertained the company with some slight of hand tricks at which he is much better than a good many professionals. The Hull Electric Railway gave a luncheon the next day. The business discussed at the convention was private. It has not yet been decided where the next convention will be held.

Illumination

Globes and Reflectors for the New High Candle Power Mazda Lamps

It is difficult to classify all of the uses to which the new nitrogen lamps will be put, for they undoubtedly bring revolutionary changes wherever high candle-power units are required, and because of their simplicity will be instrumental in opening many new fields for the use of artificial light. They are particularly adapted to the lighting of large areas, especially where the units must of necesssity be hung high, as for example, such cases of industrial lighting where cranes, derricks, etc., make low suspension of the units either impractical or impossible. Stores, auditoriums, armories, railway concourses and hotel lobbies are representative of a large class of interiors in which these units can be used to advantage, with direct, semi-indirect or totally indirect fixtures, as the individual cases may require. In general where the ceilings are high, the direct system of lighting can be used with satisfactory results; where the ceilings are low, the semi-indirect or indirect systems are recommended. The lighting of such outdoor areas, as athletic fields, motor dromes, yards and amusement parks can be advantageously accomplished by the use of these large units.

It is evident to all who have studied these new units that unusual care must be taken in selecting globes and reflectors that will give the maximum illumination on the desired plane, without the objectionable glare affecting the visual acuity of the eye.

The reflectors and diffusing units shown in the accompanying illustrations have been designed for use with high efficiency, 500 and 1,000 watt lamps.

Fig. 1 is designed for semi-indirect lighting of large interiors. This unit is supplied with a prismatic reflector, covered by a Druid stalactite. The indirect light given by the reflector produces an almost shadowless illumination without the large volume of direct light given by ordinary semi-indirect units.

The units shown in Figs. 2 and 3 are both designed for large interiors, being particularly suited for high class stores,

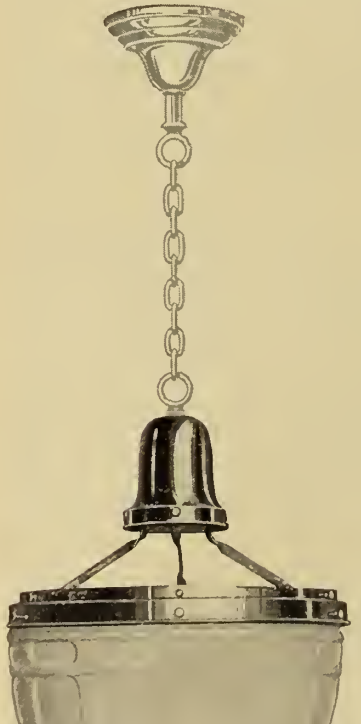


Fig. 1

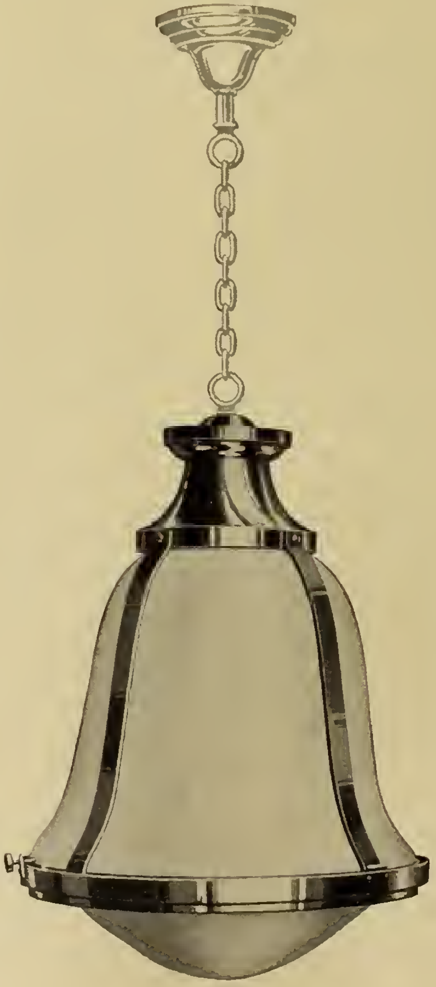


Fig. 2

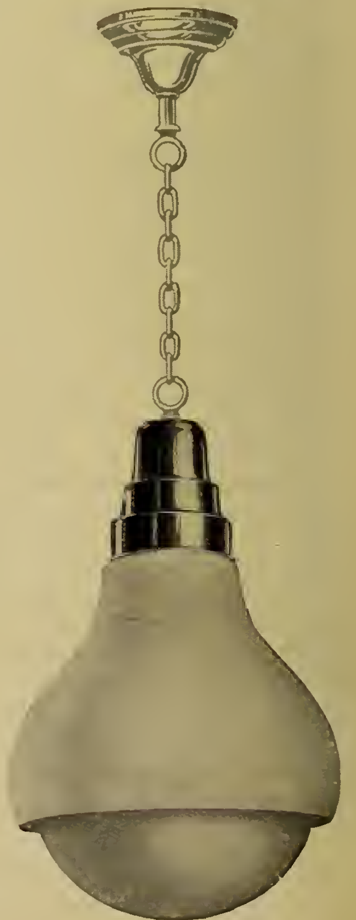


Fig. 3

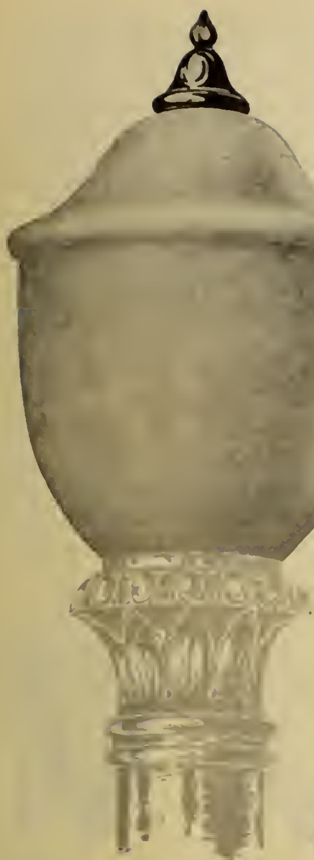


Fig. 5

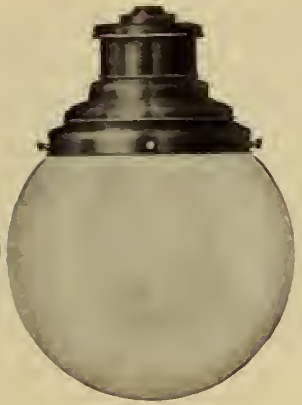


Fig. 4

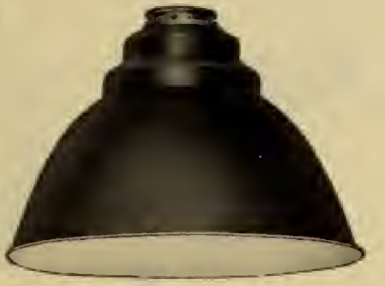


Fig. 6

hotel lobbies, theatre foyers, armories and large auditoriums. The Pyro reflector and C. R. O. bottom make units of excellent appearance and good efficiency. Special ventilation in band and fitter provide against excessive heat and special supporting devices in the fixtures insure that there will be no strains to cause breakage.

Fig. 4 consists of a specially ventilated fixture with an opal glass ball having a ¾-in. hole in the bottom. The top is tapped for suspension from half inch pipe. This fixture is weatherproof and can be used outdoors. A small porcelain reflector is used inside the fixture to add to the efficiency of the unit. Another type called the "White Way" unit, is especially made for outside use,—street, theatre or store front lighting. It is similar to Fig. 4 but has a twenty-inch radial reflector.

Fig. 5 is a handsome street lighting unit. This new unit with a Pyro top and C. R. O. bottom shows excellent efficiency, good diffusion, is low in cost and distributes the light in a manner almost ideal for street lighting. It is furnished complete with a fixture designed to separate the glass parts from one another for proper ventilation. There is a large field for the new mazda lamps in street lighting. Ornamental standards with multiple lamps permit the better spacing of units, provide more useful light, better distribution, freedom from overhanging obstructions and greater beauty in effect.

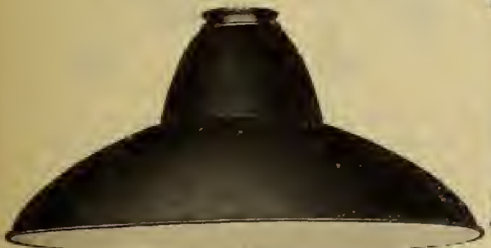


Fig. 7

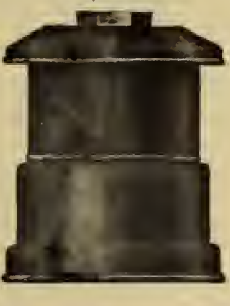


Fig. 8

For industrial, platform and outdoor lighting, where conditions for high mountings permit of open reflectors, the reflectors shown in Figs. 6 and 7 should find a considerable field. Fig. 8 shows the attachment which completes the unit for outdoor use. It consists of a ventilated enamel hood including mogul socket.

The types shown herewith are the product of the Holophane Section of the Canadian General Electric Company, Limited.

Illumination an Important Factor in the "Safety First" Movement

A paper was recently read by Mr. R. E. Simpson before the Illuminating Engineering Society, New York section, on the subject of "Illumination as a Safety Factor in Industrial Plants." In these days when such strenuous efforts are being put forth to preserve not only the life but the working capacity of the individual it is too often lost sight of that many of the accidents to workers engaged in industrial life of one kind or another are very often attributable directly to poor light. This is all the more deplorable since the means for providing excellent illumination are now obtainable at minimum expense. There is, however, an almost unaccountable indifference shown by the management of many of these plants to their system of illumination. Scientific data shows conclusively, however, both that the number of accidents is reduced and that the quantity and quality of the work is improved under corrected conditions. Mr. Simpson's paper gives some interesting statistics in connection with this matter extracts from which are reproduced herewith.

Of the 50,000 yearly avoidable accidents that occurred in the United States, possibly 25 per cent. are due directly or indirectly to inadequate illumination. Reports of the various state labor bureaus and by the federal government give the number of accidents classified under various heads, such as breaking of hoists, cranes, winches, etc.; bursting of grindstones, etc., contact with mill gearing, persons falling or being struck by falling tools or other objects; but rarely, if ever, is poor illumination among the causes, although many of the reports mentioned this as an indirect or contributory cause.

The evidence that poor illumination is the cause of accident is so hard to get, and so few statistics are kept as to this cause that very few employers consider that a large proportion of their accidents are due to the improper use of light.

For the purpose of showing the relation of illumination and accidents, two curves are shown herewith. One, Fig. 1, illustrates the relation of daylight to accidents and shows the number of persons fatally injured in a large group of plants covering a period of three consecutive years, grouping the accidents according to the months of the year. It will be seen from this that during July, August, September, March, April, May and June, the number of accidents per month for the entire three-year period remains practically constant at about 150. In other words, when the day was long enough to give good illumination throughout the working hours, the number of fatal accidents was fairly uniform. When the hours of darkness increased, however, the number of accidents increased also, so that in December and January it was no less than 40 per cent. greater than normal. That the connection between accidents and daylight is close is shown with remarkable clearness by comparing the "accident curve" with the curve showing the "hours of darkness" throughout the year. This curve, Fig. 2, shows the hours of darkness at the latitude of Hartford, Conn., for each calendar day of twenty-four hours, considering, for the sake of brevity, darkness to signify the period between sunset of one day and sunrise of the next day following. When the nights are short enough to insure a good light throughout the working day, a further shortening of the period of darkness would not diminish the number of day accidents, but would affect only night labor. Therefore, assuming a period of darkness less than twelve hours would have no effect on the day accidents, the straight horizontal lines A B and D E have been drawn at a height corresponding to a twelve-hour night. By comparing the heavy line darkness curve with the accident curve, a striking similarity is found.

Many instances of fatal accidents are at hand that have resulted to workmen in factories where only local illumination is provided. In these cases the men worked in a small zone, very brightly lighted, and when it was necessary to move out of this zone for any reason, the eye was unable to adapt itself to the lower intensity with sufficient quickness to prevent stumbling over obstacles.

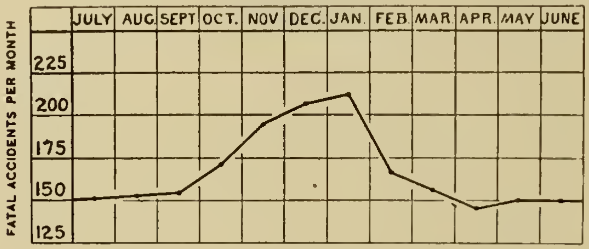


Fig. 1.—Relation of daylight to accidents.

It is suggested that where moderate local illumination is used a minimum general illumination of about 0.2 foot-candle should be provided in all parts of the working space and where the local illumination is high or where the work is done on bright metal parts, highly reflective surfaces, or locations with moving machinery, this general illumination should be raised to about a minimum of 0.5 foot-candle.

Perhaps the greatest number of accidents due to inadequate illumination are caused by falls, and from the report of the British factory inspectors for 1911 it appears that for 379 fatal accidents caused by machinery moved by mechanical power there were also 377 due to persons falling. Very few industries are exempt from this danger, and it is especially true in building construction, ship building yards, and machine shops where the working area is very large in comparison with the number of men employed, and where the system of lighting could be described as illuminated spots around where the work is done most of the time, with large dark areas intervening.

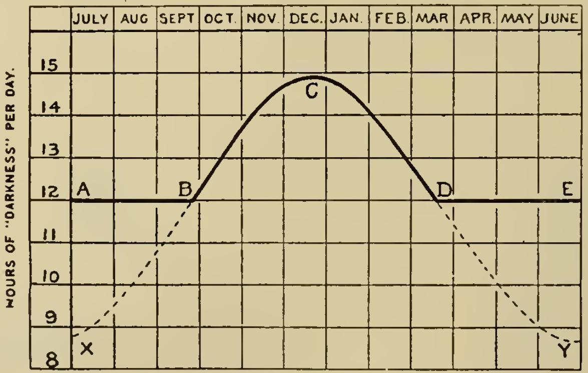


Fig. 2.—Working hours of darkness, by month.

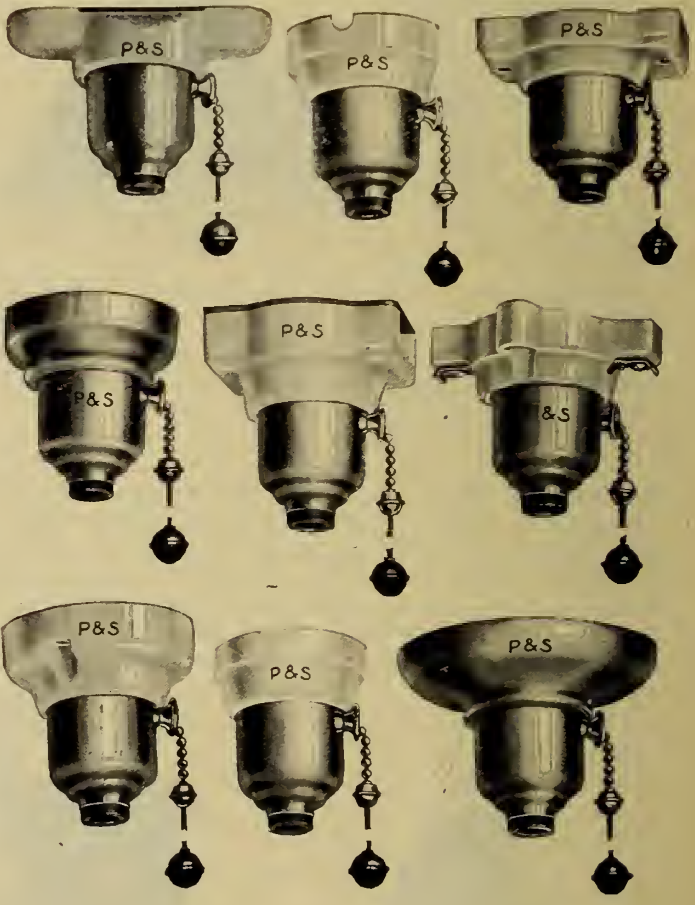
Most managers provide sufficient light for the immediate working space and pay no attention to the stairways ond halls, with the result that many fatal accidents are due to this cause.

Much harmful lighting has been caused by the introduction of the high efficiency tungsten lamps without due regard to the increase in the brightness of the filament. In many cases tungsten filament lamps have simply replaced carbon lamps without any reflector, or simply with some inadequate devise that did not cover the filament. Thus while the aggregate candle-power in many factories has been increased, the bad effects of glare have in many cases made the conditions worse rather than better.

There is a crying need for a greater concentration of effort for the protection of the ultimate consumer of light—the eye. Engineers and chemists have evolved lighting units which if properly applied, will produce adequate illumination in our factories at a cost so slight that it is out of all proportion to its importance.

New Pull Switch Rosettes

The accompanying illustration shows new types of pull switch rosettes manufactured by Pass & Seymour, Inc., and embodying the Fluto interchangeable feature. These rosettes are all supplied with a short chain to which is added ten feet of black linen cord and black acorn permitting the use of the eyelet or pulley to which the cord may be carried to enable it to be operated at some distance. It will be noted from the illustrations that a wide range of bases is provided permitting the use of these rosettes on cleat work, outlet box work or ordinary concealed wall work, as well as for taplets, conduit box, adapti work, etc.



The Canadian Laco-Philips Company, Limited

The Laco-Philips Company of New York have sent out notices advising the incorporation of the Canadian Laco-Philips Company which has acquired the Canadian business of the parent company. It is stated that all the Canadian lamp contracts have been taken over by the new company and that hereafter all Canadian orders for Laco lamps will be attended to by the new company.

The Dealer and Contractor

The Percentage System in Electrical Contracting

A system of charging that is making considerable headway in the electrical contracting business is that computed on a cost plus percentage basis. For the less experienced contractor there is much to commend this practice in that he avoids some of the disastrous under-estimates which have been the means of too often putting the beginner out of business. On the other hand, it is a difficult matter to decide just what the word cost should be interpreted to mean and to determine just what percentage addition is reasonable. Contractors, as a whole, undoubtedly still incline to the opinion that the straight competition, taking into consideration not only price but also skill, reputation, etc., is the most satisfactory for all parties. The percentage system, however, has many friends. In this connection an interesting paper appears in a recent issue of the Electrical Review by Mr. G. D. Crain, Jr., which views the matter from both sides. We print this paper in part below.

One of the most important and interesting developments in the electrical contracting business, as in other departments of building construction work, is the use of the percentage system. As the name suggests, this plan involves awarding business to the contractor on a basis of an agreed percentage above the cost of labor and materials.

The defects of the system of bidding are obvious. In the first place, there is an element of uncertainty which sometimes results in the contractor handling an important job at an actual loss. Unforeseen elements of difficulty may arise, and the delay and increased expense thus made necessary eliminate all possibility of earning a profit.

The average owner is willing that the contractor make a fair profit on his work; and it is also plain that if a contractor sees that he is likely to lose money on a job he will be tempted to "cut the corners" wherever possible for the sake of making his net loss as small as possible. This does not always happen, of course, for many concerns would rather lose money on a piece of work than risk losing the good-will of the customer. Nevertheless, the temptation to slight the quality when it is found that a bid which is too low to cover the cost has been made, is present, and it doubtless has its effect in a good many cases.

On the other hand, the very fact that the wise contractor appreciates the risk involved in bidding, since it is never possible to anticipate every feature which may arise, means that a larger margin must be allowed to take care of the unknown quantities than would be necessary if every point were covered by the bid. The contractor who would be willing to make 15 per cent. "for sure" on every job will probably allow 25 per cent. in bidding in order to cover the unexpected difficulties that may arise, and also to take care of other jobs where the net had been considerably below the expected profit.

That means that in some cases the owner pays more than a fair price for the job. He is helping to average up the general run of work, and his excess payment offsets the too small amount charged on an unprofitable job. This is obviously an inequitable system, and furnishes a legitimate argument for the use of the percentage system.

One of the chief advantages to the contractor is that he can get the benefit of accumulated good-will and the prestige which goes with a record of big jobs well handled. While it is not necessary that the architect let the contract in every case to the low bidder, the inclination is always in that direction, and thus the inexperienced and the unskilled, who know neither how to figure the cost of a job nor how to handle it to the best advantage, are likely to get work to which those who have proved themselves in previous jobs are really entitled. That is one of the glaring weaknesses of the present system. The lowest and best bidder is the man to whom the contract, in theory, should be awarded, but in actual practice it is the low man more often than the best who gets the business. Contractors have learned this, and know that only when their bid is pretty close to the bottom will they be given serious consideration.

The percentage system eliminates all this. It puts a premium on efficiency and high-grade work. If the Johnson Electrical Company did an excellent piece of work in wiring a storeroom for James Martin, architect, and Mr. Martin has another job in which particularly careful work is required, he would much rather be sure of Johnson getting it, by making a percentage agreement, than have to take bids and feel called upon to let the contract to the low man, irrespective of his previous record, and without regard to whether the architect himself had tried him out on other work. That makes the percentage plan easy and convenient for the architect.

Then, too, many an owner has a friend in the business whom he would like to favor. Under the open bidding system he does not feel justified in apparently throwing away money merely to favor a friend. Consequently if somebody else bids lower than the concern he is acquainted with, it is seldom he interposes a request to give the contract to the higher man. With the percentage system, he can do this without feeling that he is making the job cost him more than a fair price. He is sure of getting it at a proper charge, for labor plus material plus profit should be easy to figure.

It must not be thought, however, that the percentage idea solves all problems, and makes life's path easy for the contractor. There are difficulties and irritations involved here as well as under any other system, for no change in methods will change human nature. The contractor who is inclined to beat the owner under a bidding system will probably attempt the same thing under a percentage plan.

In fact, cases have been cited in which the contractor padded his expense bills, charging the owner the list price for material, without showing the discounts received. Time for labor was also increased, helpers being put in at mechanics' prices, and other features of that kind developing. Carelessness in buying and using material when the owner is footing the bill is also apparent in some jobs handled on a percentage plan, and when this occurs the system is given a bad name.

Another difficulty is determining just what the percentage should be. And, after all, here is an opportunity for bidders to be pitted against each other, for the man who agrees to do the work for the smallest percentage over and above the cost of the material and labor, other things being equal, is likely to get the job. So adopting this plan does not entirely solve the problem, by any means.

One large contractor in an Ohio Valley city believes that 20 per cent. plus a proper charge for supervision, is a fair basis on which to handle the business. He points out that he is entitled to a profit both on the material used and on the labor supplied, and that it likewise costs money to have the work properly supervised, supervision not being included in the labor item, as a rule. But sometimes he finds that other contractors are willing to eliminate the supervision charge, and also to shrink the percentage of profit, the incentive to the man who has no very high principles for the conduct of his business being so obvious that a good many of them will take the work for almost nothing in order to have an opportunity to make money by "faking" their bills.

"The percentage plan has been given undeserved unpopularity among certain owners and architects," said the head of the concern referred to above, "because of their experience in dealing with contractors who did not play fair. It might be said that under such a system the owner would be foolish to give his work to anybody except those he knows he can trust completely. But if one man is willing to work for a smaller margin of profit than another, he is likely to be given the work. The contractor of this kind may think that it is legitimate to make up for a narrow margin of profit by padding his bills, and get his profit in some other way; but we believe in laying all our cards on the table and stating in the beginning just what the charge is going to be, above the cost of labor and material."

A phase of the plan which seems to meet the objection that the contractor has no incentive to work out effective methods of cutting costs and reducing the expense of a job, in view of the entire cost being borne by the owner, is the award of a bonus. The architect figures an estimate, which is agreed upon as representing the probable cost of the job, and the contractor gets 50 per cent. of any saving made in the work compared with the original estimate. This makes it worth the while of the contractor to reduce the expense wherever it can legitimately be accomplished, and gives him something to work for. This plan has been used successfully in a good many cases.

The percentage idea is undoubtedly interesting. It has its defects and drawbacks, but appears on the whole to mark an improvement over the typical system.

300 to 5,000 Volt. A.C. Lightning Arresters

The essential functions of good lightning arresters are threefold.

(1) They must be sufficiently sensitive to discharge to earth abnormal transient stresses of potentials slightly higher than normal line voltage.

(2) They must be capable of instantaneously restoring the circuit to its normal condition by cutting off the flow of dynamic current which tends to follow in the path of the static discharge.

(3) They must be capable of restoring themselves to their normal condition instantaneously so as to be ready to earth the rapidly recurring discharges, which usually make up a lightning stroke.

The Canadian General Electric Company announce that they offer two types of arresters embodying features which take care of the duties outlined above. These are known respectively as the Graded Shunt Multigap and the Compression Chamber Multigap lightning arresters. They are both designed with low uniform resistance, the resistance rods being glazed to prevent scintillating, or arcing over, from end to end. The gaps in the graded shunt type are mostly shunted by resistances, offering a selection of paths to earth for the discharge. The compression chamber type employs a smaller number of gaps, their sensitiveness being enhanced by the effect of the antennae placed in close proximity. The flow of dynamic current is positively and practically instantaneously cut off in both these types by the rectifying properties of the vapors emitted from the gap metal, which interrupts the flow of current and extinguishes the arc at the end of the half cycle. No moving parts are used in either type of arrester, and therefore there is no time elapsing when the arrester is not ready for duty. This is particularly important in the case of rapid recurring discharges. The lack of moving parts also eliminates the necessity of frequent inspection and adjustment, due to the liability of moving parts to get out of order. Graded shunt and compression crusher arresters protect, and are not designed to save themselves at the expense of the equipment they are installed to protect.

Electric Impulse Clocks

The illustration herewith represents a type of impulse clock manufactured by Gent & Company, Leicester, England. This company manufactures what is known as the Pulsynetic system of electric impulse clocks for indicating uniform and correct time throughout residences, hotels, institutions of various sorts, works, factories, etc. This modern impulse clock system consists of (a) an impulse transmitter; (b) the clocks or impulse dials; (c) wiring. Every dial in the whole system is absolutely governed by a transmitter which has a compensated pendulum guaranteed to within a few seconds per week so that uniform time and correct time is maintained on every dial. This system of impulse clocks can be extended indefinitely both as regards number and size of dials. Gent & Company have also just published interesting catalogues covering their patent electric watchman's and tell-tale clocks designed for checking the movements of night watchmen in warehouses, factories, mills, hotels, etc., and for assuring strict attention to duty on the part of night nurses and attendants in asylums and hospitals. Another catalogue illustrates and describes their secret inter-communication telephones.

Escher Wyss & Company, Montreal, have received an order from the City of Edmonton for a 6,000 kw. Zoelly steam turbine set, running at 1,800 r.p.m.

Five Degrees of Light

There has recently been put on the market a device called the Dim-a-lite which makes any lamp a "Turn down lamp." This device is merely a small rheostat which can be attached to any lamp socket. It is constructed as illustrated herewith. The device is suitable for any lamp and any current and may be attached in a few seconds. The pulling of the chain gives five degrees of light: "full," "dim," "low," "night light," and "out." The Dim-a-lite makes an ideal hall light for any room. The ordinary electric light is often too bright when turned up and leaves total darkness when turned out. Another point about the device is that at the low lights there is a saving of current. Tests made in the Bureau of Standards, Washington, show approximately a saving of 75 per cent. at the lowest light. These devices are being sold in Canada by the Benjamin Electric Manufacturing Company of Canada, Limited, Toronto.

Travelling Trolleys

We have just received from the Herbert Morris Crane & Hoist Company, a copy of their newly issued bulletin B5 which is entirely devoted to the various types of travelling trolleys made by this company. These Morris trolleys are of many patterns to run either on a flat-bar track, or on the lower flange of an ordinary steel I-beam. Some of them are prepared for short straight runways, while others, containing suitable swivels, are flexible in a horizontal direction, and thus permit of the use of curves or "bends" in the track. The bulletin contains a great deal of practical information of immediate interest to all users of this kind of equipment. The illustrations, diagrams and tables of dimensions and prices are arranged in a handy and useful form.

New Resistance Casing for I-C Starting Rheostats

The Independent Electric Manufacturing Company of Milwaukee, Wis., have developed and are placing on the market a new type of resistance casing for starting rheostats and controllers. The casing or the resistance box itself, in which the resistance units are mounted, is of cast iron and in the sides of the box, at the top and the bottom, there are four large ventilating openings. These openings are covered with heavy non-corroding screens of fine mesh which allow free passage of air into the box and positively prevent any sparks or flames emanating from the box in case of a burn-out of the units, the principle being the same as on the safety lamps which have been employed successfully for years in the mining industry. There are no external openings whatever in the bottom plate of the box so that should a burn-out occur, the molten parts dropping to the bottom of the box are absolutely prevented from falling to the floor. This box has been examined and approved by the Underwriters' Laboratories.

German Glassware in Canada

Max Kray & Company, Berlin, Germany, one of the largest manufacturers of lighting glassware in the world, have made arrangements for placing their line in this country. Rau, Voss & Company, with offices at 162 Bay Street, Toronto, will be the sole Canadian agents. This office is now operating, under the management of Mr. G. Helliken. Rau, Voss & Company will carry a complete stock of their very extensive line of small gas and electric shades, globes and balls, also a line of dishes, bowls and urns for semi-indirect lighting in a variety of glasses, treatments and decorations. In addition to the above specialties they will carry the regular staples, air hole chimneys, electric bulbs, etc. Of particular interest in the line is the special glass which they have named Onyxit, which is capable of innumerable treatments, thus producing an endless variety of effects. Mr. Bernhard Schneider, managing director of the company, is at present in Canada getting the line started.

The Electrose Manufacturing Company, Brooklyn, N.Y., will have an extensive exhibit of their high tension insulators and insulating parts at the Hotel Walton, Broad and Locust Streets, Philadelphia, during the N. E. L. A. convention week.

The Mac Electric Company of Ottawa, have recently added several agencies to their line, extending business in the Ottawa district, among them being the Lindsley Bros. Company, of Spokane, Wash., dealers in cedar poles, and the Thurman Vacuum Cleaner Company, St. Louis.

Trade Publications

Small Motors—Booklet issued by the Robbins & Myers Company, Springfield, Ohio, entitled "Doing the World's Work."

Frequency Meters—Bulletin issued by Roller-Smith Company of Chicago describing the Hartmann & Braun vibrating reed frequency meters, variation alarms and relays.

Rope Drives—Bulletin O issued by the Mesta Machine Company, Pittsburgh, describing the advantage of rope drive and containing information on the length of life of manila ropes.

Water Meters—Bulletin No. 16 issued by Canadian Allis-Chalmers, Limited, describing and illustrating Cochrane hot water meters for which this company are exclusive Canadian agents.

Burke Switches—Folder issued by the Railway & Industrial Engineering Company, Pittsburgh, drawing attention to the valuable features of Burke switches for sectionalizing transmission lines for outdoor stations, etc.

Good Service—A booklet issued by the Electric Maintenance & Repairs Company, Toronto, entitled "The House of Good Service." This booklet is distributed with the object of drawing attention to the different lines this company handle and the kind of work they do.

Pressed Steel Case—Catalogue issued by the Pittsburgh Transformer Company describing their new distributing transformers enclosed in pressed steel cases. The catalogue contains useful information regarding the erection of transformers together with other interesting data.

C. G. E. Publications—The Canadian General Electric Company have issued Bulletin No 43401 entitled "Modern Lighting Practice in the Clothing Industry;" also Bulletin No. 48010 on "Electricity in the Shoe and Leather Industry." Both of these catalogues are well illustrated and contain much useful information.

Buckeye-Mobile—Bulletin No. 111B issued by the Buckeye Engine Company of Salem, Ohio, describing a type of engine which combines in a single unit the ordinary factors of a high grade steam plant, namely, a boiler, engine and all auxiliaries. It is claimed for this apparatus that it will develop a brake horse power on less than 1½ lbs. of coal. It is manufactured in sizes from 75 to 600 B.h.p.

Current News and Notes

Bolton, Que.

The plant of the Bolton Light, Heat & Power Company is valued by the Hydro-electric Power Commission of Ontario at $7,500. The question of the municipality taking over the plant is now under discussion.

Carlyle, Sask.

Work is at present in progress on the erection of a municipal electric distribution system for domestic and street lighting.

Canso, N.S.

The town of Canso will install during the present summer a complete light and power plant. A gas producer engine generator set of 100 h.p. capacity will be put in.

Chatham, Ont.

Negotiations have been opened again for the purchase, by the city, of the plant of the Chatham Gas & Electric Company.

Clinton, Ont.

On May 19th hydro-electric power was officially turned on in this town.

Colonsay, Sask.

The Colonsay Rural Telephone Company are calling tenders for the supply of material and the construction of a telephone system.

Dryden, Ont.

A by-law authorizing $7,000 to be spent on a municipal telephone system will be voted on shortly.

Duncan, B.C.

A contract has been awarded to Robert McLay for the construction of a brick power house.

Edmonton, Alta.

Mr. Bion J. Arnold, consulting engineer, Chicago, was in Edmonton on May 18th at the instance of the Edmonton Interurban Railway to advise as to the most economical form of motive power for their line to St. Albert; also as to the advisability of building a line to Fort Saskatchewan eighteen miles east of Edmonton. The car barn and rolling stock consisting of one gasoline electric motor car was destroyed by fire early in April.

Gananoque, Ont.

The Gananoque Electric Light Company have awarded a contract for an addition to their power house.

Gravenhurst, Ont.

A contract has been awarded by the town council to Etler & Clift, Gravenhurst, for the erection of a sub-station required here.

Halifax, N.S.

Premier Murray recently explained in the local house that he had already had a report made by a competent engineer as to the best means of conserving and developing the water powers of the province so that they might be of the greatest value to the citizens at large. It was also stated that a bill would be brought in providing for the appointment of a water power commission whose duty it would be to devise just and practical rules respecting the preservation and control of the running waters and water powers of the province.

Foley Bros., Welsh & Stewart, Ottawa, who have the contract for the depot construction work in Halifax are installing their own electric power equipment. They have already on order two 100 kw., d.c. steam driven generators for construction purposes, including pumping, drilling, lighting, etc.

Halifax Electric Tramway Company are considering the installation of another 2,000 kw. high pressure turbo-generator set.

Kindersley, Sask.

The South Valley Telephone Company have awarded a contract to the Kindersley Construction Company for the erection of their telephone system.

Lacombe, Alta.

A by-law will be submitted asking authority to purchase a steam boiler for the electric light plant.

The Lacombe & Blindman Valley Interurban Railway are making good progress with their grade and they expect to have part of it in operation this year. This road will operate a gasoline electric motor car and will eventually connect Lacombe with Edmonton. The right of way is from 10 to 20 miles west of the present Calgary and Edmonton Railway. The order for steel has been placed with the United States Steel Products Company and the order for the motor car will soon be placed.

Lachine, Que.

By a majority of ten to one, the electors of Lachine, P.Q., have passed a by-law for improvements, including a large sum for laying underground conduits.

Leduc, Alta.

A by-law was submitted on May 20 authorizing the expenditure of $15,000 on an electric light system; most of the contracts are already let.

Morse, Sask.

A contract has been awarded to Mr. W. D. Craig, Regina, for the erection of a telephone line for the Morse Rural Telephone Company.

Montreal, P. Q.

Justice Mercier, of Montreal, has decided that an electrical contractor is not bound to do his work in compliance with the regulations of the insurance companies unless it is so stipulated in his contract. The Routtenberg Company ordered a $400 electric sign from the Macey Sign Company, but when the sign was delivered refused to pay for it, claiming the wiring was not up to the Underwriters' standard. The court held that the sign had been made in accordance with all the requirements of the contract, and that therefore payment must be made.

The Nova Scotia Steel and Coal Company have placed an order with Fraser and Chalmers, Montreal, for a 2,000 kw. steam turbine direct connected to an alternator to be supplied by Vickers, Limited, Montreal, including switch gear and complete condensing apparatus.

New Westminster, B.C.

Arrangements have been made for supplying the new Royal Columbian hospital at New Westminster with electricity for four 45 ampere cooking stoves, elevator, return call signal system and laundry.

Niagara Falls, Ont.

By a recent bill at Washington the Secretary of War for the United States is given the right to issue revocable permits for a daily diversion from Niagara River averaging 15,-

600 cu. ft. per second on the United States side and for the importation of 250,000 h.p. from the Canadian side.

Ottawa, Ont.

The Ottawa Municipal Electric Commission are now selling electric supplies. On Wednesday, May 20th, the office staff vacated the quarters on the ground floor of the city hall for which a rental of $1,500 had to be paid to the city and moved into larger premises on the ground floor at 207 Sparks Street, within two doors of the corner of Bank and Sparks sterets, the centre of the city, at a rental of $1,890 yearly. The front part of the new quarters will be used as a store and the back part as the offices. The Commission now expect to get considerably more business and the profits on the sale of electrical supplies will, it is anticipated, more than pay for the increase in the rent.

Pembroke, Ont.

A by-law was recently carried granting a bonus of $5,000, a loan of $50,000 and fixed assessments to the Electric Manufacturing Company of Canada.

Prince Albert, Sask.

It is expected that a by-law will be submitted in the near future regarding a franchise to be given a private company for the construction of an electric railway.

Prince Rupert, B.C.

In connection with their new hydro-electric undertaking the Prince Rupert Hydro-Electric Company are purchasing a 1,650 h.p. Canadian Allis-Chalmers water wheel direct connected to a Canadian General Electric 4,400 volt generator and direct connected exciter; also a complete switchboard, Tirrill regulator and lightning arrester equipment. This plant is to be designed and erected by the local staff of the corporation, Mr. W. St. George Mason, city engineer, and Mr. T. C. Duncan, electrical engineer. The Prince Rupert company is at present operating with a steam plant of moderate capacity. It is anticipated that with the completion of the hydro-electric scheme a substantial reduction in power rates will be put into force, an innovation which no doubt will be attended by considerable development in the industrial life of the city.

Regina, Sask.

The operation returns for the municipal electric railway system, Regina, for the week ending May 9 are as follows:—revenue, $4,096.50; passengers carried, 97,901; passengers carried including transfers, 109,681. Corresponding figures for week ending May 16 are $3,720.55; 89,039 and 99,960.

Renfrew, Ont.

The council has received an estimate from the Hydro-electric Power Commission of Ontario on the cost of street lighting. The total sum required will be in the neighborhood of $16,000 and it is probable the work will be proceeded with in the early summer.

Revelstoke, B.C.

The city of Revelstoke will install another hydro-electric unit this summer and have purchased from Escher, Wyss & Company an 1100 h.p. turbine to operate under a head of 73 feet. An order for a 3-phase, 2300 volt, 750 kv.a. generator with direct connected exciter and switchboard has been placed with the Canadian Westinghouse Company.

St. Thomas, Ont.

The Michigan Central Railway Company have recently installed a small isolated plant. The engine was supplied by E. Leonard & Sons and a 375 kv.a., 575 volt, 3-phase, 25 cycle generator by the Canadian General Electric Company.

Strathroy, Ont.

Extensions to the street lighting system are contemplated, the work to be carried out during the present summer.

Stratford, Ont.

A by-law recently carried to expend $21,000 on extensions to the street lighting system.

Three Rivers, Que.

The city of Three Rivers, P.Q., have decided on an improved system of electric lighting, and have appointed Mr. James Bennett, Board of Trade, Montreal, their consulting electrical engineer, to draw up plans and specifications. It is intended to carry out at present only a section of the scheme to replace the existing arc lights with single arc lights on ornamental standards, spaced at distances of 180 ft. and 200 ft. Conduits are to be constructed for placing the wires underground. The current will be supplied by the North Shore Power Company. The Council are also considering the question of renewing the franchise for street and private lighting at present held by the North Shore Company.

Toronto, Ont.

The general manager of the Toronto Hydro-electric System, Mr. H. H. Couzens, has been given instructions by the Board of Control to make a thorough investigation into the possibilities of the combination of a stand-by turbo-generating plant with a steam heating plant.

Vegreville, Alta.

The town of Vegreville have let a contract for two vertical, high speed engines to Goldie & McCulloch Company, Limited, of Galt, Ont., and for two 2200 volt, 60 cycle, 3-phase generators of 62½ and 94 kw. capacity respectively, to the Canadian Westinghouse Company; pole line material to the Mainer Electric Company of Winnipeg and copper wire to the Northern Electric Company.

Verdun, Que.

The council have decided on the expenditure of some half million dollars to bury all electric wires in the central portion of the city. Verdun has a population of approximately 30,000. It is understood to be the intention of the council to spread this work over approximately five years.

Wallaceburg, Ont.

A by-law authorizing the purchase of the electric light plant of the Wallaceburg Gas Company is being submitted on May 28.

Waterloo, Ont.

A by-law will be submitted in the township of Waterloo giving authority to expend $18,000 on a municipal telephone system.

Winnipeg, Man.

The Winnipeg Electric Railway Company are extending their line in the municipality of Fort Garry from the end of the present line to St. Norbert. This means an extension of about three miles. The work will be proceeded with at once.

Phone Adel. 2690 **198 King. St. W.**

B. A. PERRY

Illuminating Engineer

Designer of Lighting Fixtures

Lighting Plans Laid Out and Specifications Supplied

TORONTO **ONTARIO**

Condensed Department

Publisher's Notice

Advertisements under "Situation Wanted" "Situation Vacant" or Miscellaneous, are charged at 2 cents a word per insertion, minimum charge 50 cents.

Advertisements for tenders, equipment, wanted or for sale, etc., are charged at $2.10 per inch.

All advertisements must be in the publisher's hands by the 10th or 23rd of the month to insure insertion in the subsequent issue.

Fire Alarm System

The Town of Lunenberg, Nova Scotia, invites tenders for the installation of an up-to-date Fire Alarm System, "Siren" preferred. Town very compact—about 3,000 population.

GEORGE H. LOVE, Town Clerk.

Lunenburg, N.S., May 19, 1914. 11

CITY OF KELOWNA, B. C.

Tenders Wanted

Tenders in duplicate for the supply of the following apparatus F.O.B. cars Kelowna, B.C., will be received by G. H. Dunn, City Clerk, up to 12 o'clock noon on **Thursday, June 11th, 1914**:

One—225 B.h.p., Vertical, Two Crank Compound Steam Engine.

One—Feed Water Heater.

One—Independent Air Pump and Jet Condenser.

One—150 Kilowatt, 2300 Volt, Three Phase, 60 cycle, Alternating Current Generator for direct connection to engine.

One—Exciter for direct connection to Generator.

One—Switchboard Panel to match present switchboard.

Deposit cheque of 5 per cent. required.

The lowest or any tender not necessarily accepted.

Specifications may be seen after May 25th, 1914, at the following offices:

Canadian Engineer, Montreal.
Canadian Engineer, Winnipeg.
Electrical News, Toronto.
Electrical News, Vancouver.

or may be obtained from the Consulting Engineer's Branch Office at Vernon, B.C.

C. R. YUILL,
Successor to
Mather, Yuill & Company, Limited,
Consulting Engineer.

11

Situations Vacant

Contracting Superintendent

Wanted—Superintendent for electrical contracting business having estimating experience. Apply giving full particulars to Box 26, Electrical News, Toronto. 11-12

Situation Wanted

Wanted

Electrician, thoroughly experienced, installing, operating, maintaining, armature winding and general repairs to a.c. and d.c. machinery, at present employed as chief electrician in a factory, desires change. Will be glad to give further particulars.

11 S. SHA, Three Rivers, P.Q.

Electrical Engineer

Position Wanted—Electrical Engineer, Associate A. I. E. E., age 33. Thirteen years' practical experience with D.C. and A.C. machinery, Accumulators, Line erection and maintenance, High speed steam engines and water power plants. At present in charge of Suction gas plant. Box 11, Electrical News, Toronto. 9-13

SECOND HAND ELECTRICAL MACHINERY

Bought, sold, rented, and exchanged. We have the largest stock in America. Send for our monthly bargain sheet showing complete stock with our prices.

GREGORY ELECTRIC CO.
CHICAGO, ILLINOIS
Established 1893

Electrical Machinery

Motors, Dynamos, Generators,
Electrical Pumps and Supplies.
Electrical Contractors.
Motor Repairs.

MAC ELECTRIC CO

52 Queen Street - OTTAWA

CANADIAN OFFICE & SCHOOL FURNITURE CO. LIMITED
PRESTON ONT.
FINE BANK, OFFICE, COURT HOUSE & DRUG STORE FITTINGS.
OFFICE. SCHOOL. CHURCH & LODGE FURNITURE
SEND FOR CATALOGUE

PROCURED IN ALL COUNTRIES
LONG EXPERIENCE IN PATENT LITIGATION
SEND FOR HAND BOOK

PATENTS

PHONE MAIN 2582

RIDOUT & MAYBEE
59 Yonge Street
TORONTO, - - - CANADA

We Have a Bell For Every Purpose

There can be only one best and that is the Schwarze. No. 12 Common Magneto Extension for telephone Service is illustrated herewith. The spools are large enough so that in no case is it necessary to use over No. 35 magnet wire, thereby obtaining the maximum number of ampere turns, and this wire is all active. Armature is under influence of coils its entire length. Poles arranged so that permanent magnet cannot be discharged, and will not weaken.

No. 13, same as No. 12, except larger and very much louder, and is for signalling purposes on high tension 60 cycle. Fully approved by Underwriters.

All weatherproof. Write for catalogue. All resistances.

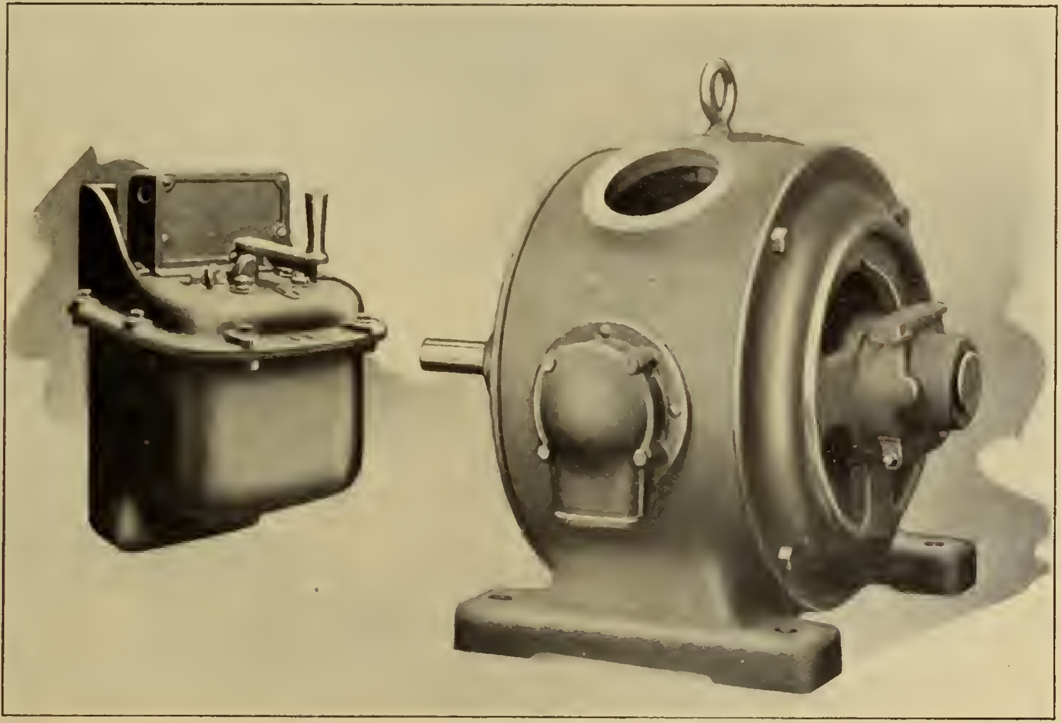
Schwarze Electric Co., Adrian, Michigan
Norton Telephone Co., Canadian Agents

SIEMENS BROS. DYNAMO WORKS | SIEMENS BROS. & CO.

SIEMENS

SIEMENS - SCHUCKERT | SIEMENS & HALSKE

Siemens' Induction Motors



Siemens' Standard Squirrel Cage Motor with auto-transformer starter. These motors are of strong construction and have large overload capacity.

We have a large stock of three phase motors up to 30 H. P. for both 60 cycle and 25 cycle 550 volt circuits, and can quote attractive prices for prompt shipment. Kindly send us your enquiries for electrical apparatus of all kinds. We undertake the complete equipment of power plants, etc. up to the largest size.

Siemens Company of Canada Limited

HEAD OFFICE:
Transportation Building - MONTREAL

BRANCH OFFICES:

STANDARD BANK BUILDING
TORONTO

McARTHUR BUILDING
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ALUMINUM
ELECTRICAL CONDUCTORS
Ingot Sheet Wire Rod Tubing

Northern Aluminum Co. Limited
1305-6 Traders Bank Bldg.
Toronto, Ont.

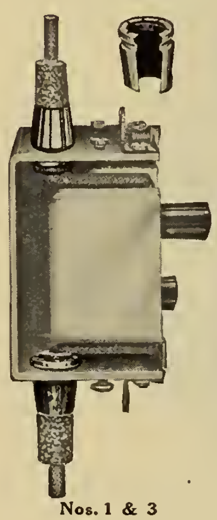
How many lamp-socket homes in your town? And are they busy?

Simplex Lamp-Socket Specialties

meet the requirements of the Dealer and the Central Station man - because they are good sellers and give long and satisfactory service.

SIMPLEX ELECTRIC HEATING CO.
Mfrs. of Everything for Electric Heating and Cooking
BELLEVILLE, ONT.
CHICAGO, 15 S. Desplaines St. CAMBRIDGE, MASS.
SAN FRANCISCO, 612 Howard St.
Member of THE RICE LEADERS OF THE WORLD ASSOCIATION

Universal Bushings
For Flexible Tubing
NEAT, SECURE AND ACCESSIBLE


Nos. 1 & 3
Patented

They grip the flexible tubing securely. Can be installed in a moment by simply slipping over the tubing.

Fits "knock-out" tightly. Permits easy removal of flexible tubing for inspection without dismantling switchbox or injuring bushing or tubing.

Nos. 2 & 4
Patented

Universal Bushings

combine function of porcelain, bushing and tape, and gives the job a finished, mechanical appearance. TRY THEM AND BE CONVINCED.

Approved by the National Board of Fire Underwriters.

WRITE FOR SAMPLES AND PRICES

New Process Specialty Co., Inc.
Enterprise Building
MILWAUKEE ∴ WISCONSIN

Back-Geared *Century*
Single Phase Motors

represent the highest grade of design and construction that you can obtain.

Rawhide pinions and machine cut cast iron gears of liberal dimensions, well protected with a gear guard—Self-oiling bearings which can not get out of line due to the bearing shell being cast with the end bracket.

4 to 1 ratio of gears in stock.

Century Electric Company
19th, Olive to Pine Sts. ST. LOUIS, Mo.

CANADIAN AGENTS
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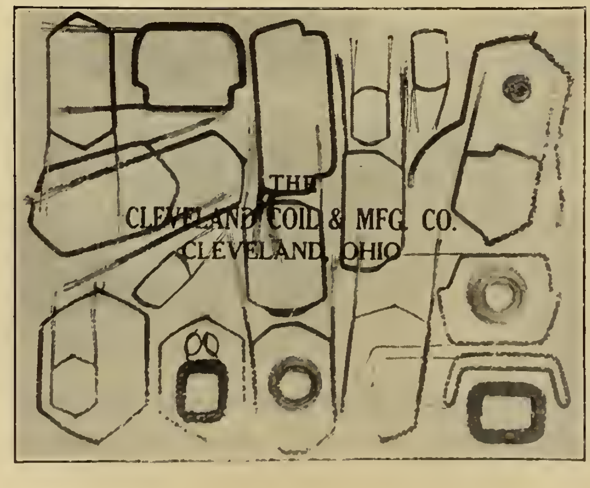
Mainer Electric Co., Ltd.
Winnipeg and Edmonton
Rudel-Belnap Machy. Co., Ltd.
Canadian Express Bldg., Mont.
Rankin & Cherrill
547 Main St., Vancouver



"YAGER'S"

stands for soldering-flux perfection—tight joints—quick, clean work—and no corroding.
You can't expect perfect joints without a perfect flux.

YAGER'S HAS BEEN KNOWN FOR FORTY YEARS AS THE ONE PERFECT FLUX.

Four Forms—Salts, Stick, Paste, Fluid.
Insist on "YAGER'S" from your dealer.
Test them at our expense.

SAMPLE ON REQUEST

ALEX. R. BENSON CO.
HUDSON, N.Y.

The WESTON SYNCHROSCOPE

Constitutes a very simple and absolute *perfect solution* of problems involved in coupling alternating-current machines in parallel without danger or sensible disturbance of circuit conditions.

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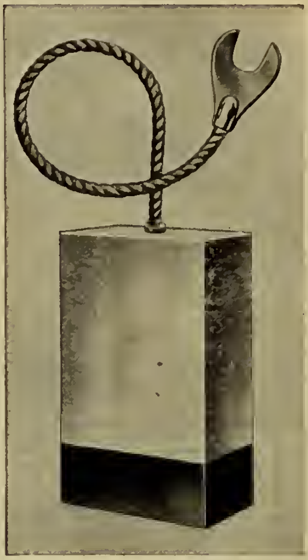

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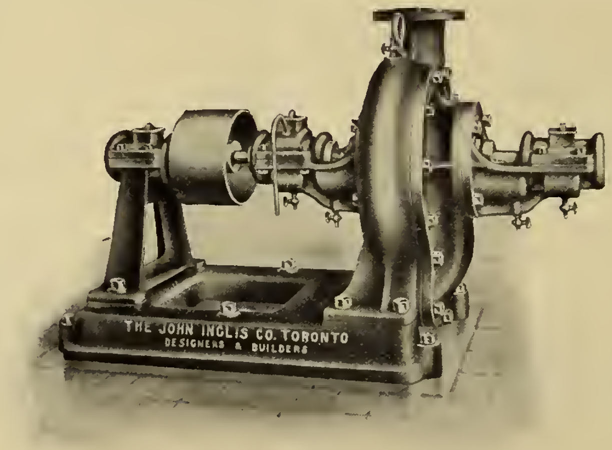

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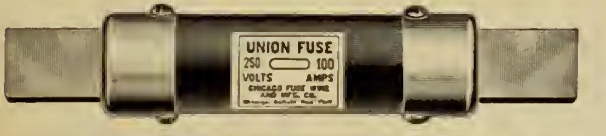

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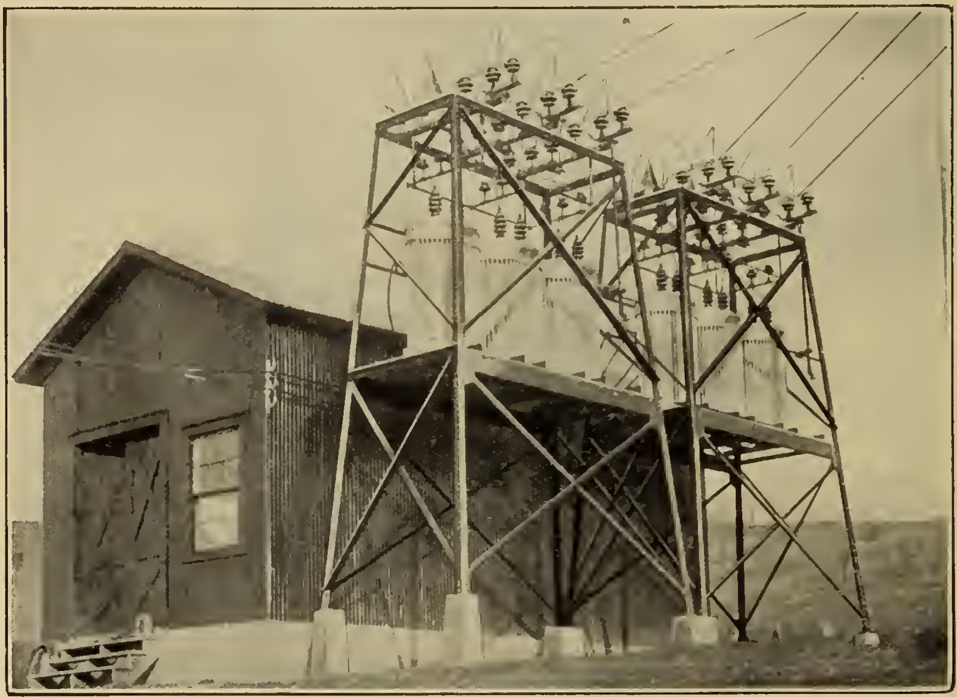

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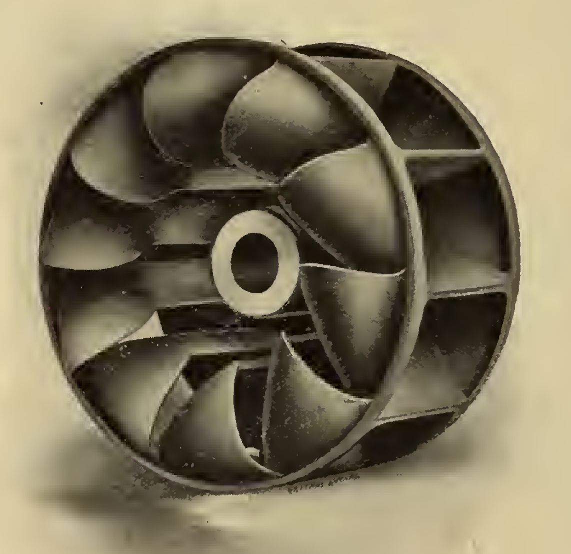

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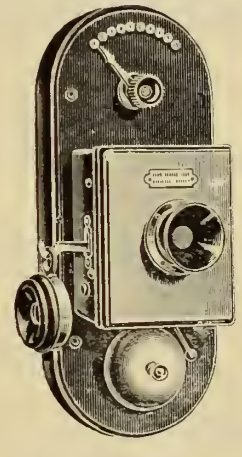

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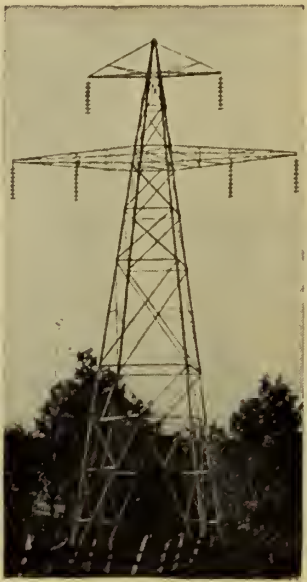

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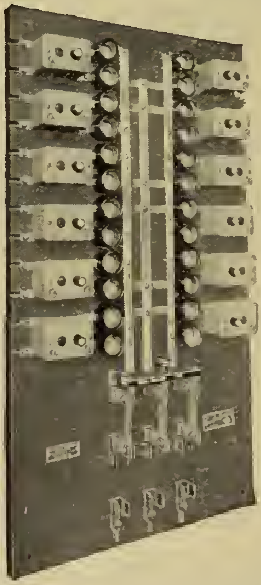

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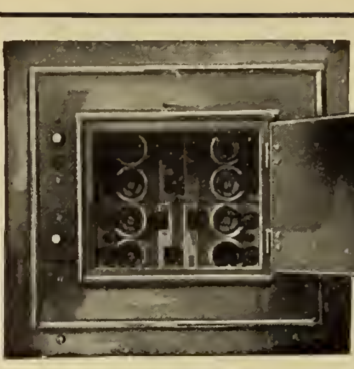

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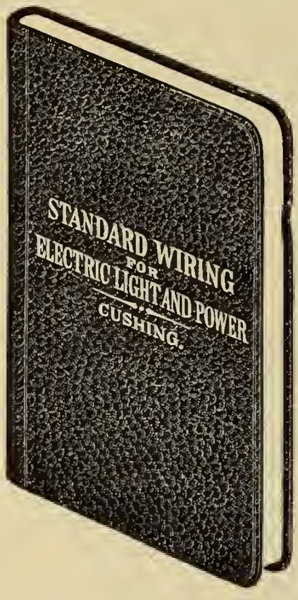

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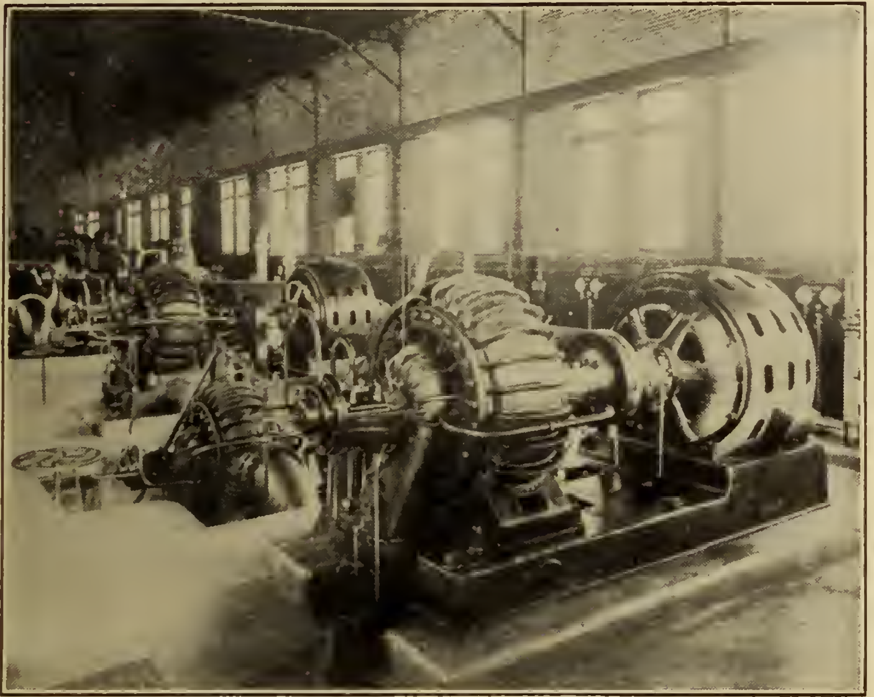

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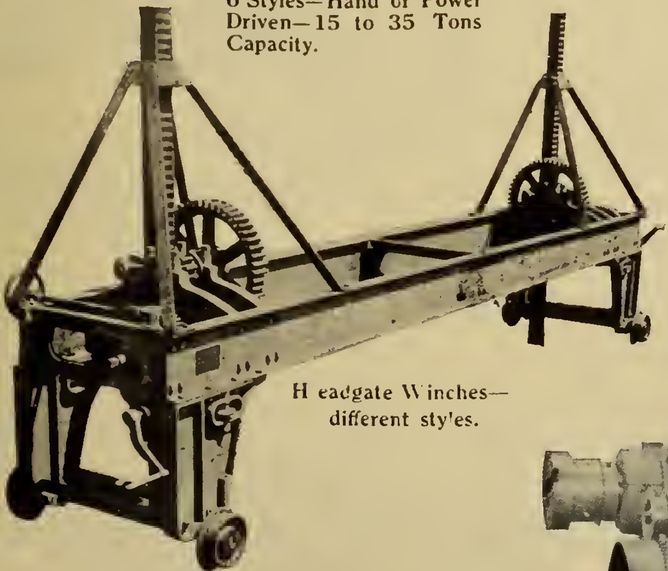

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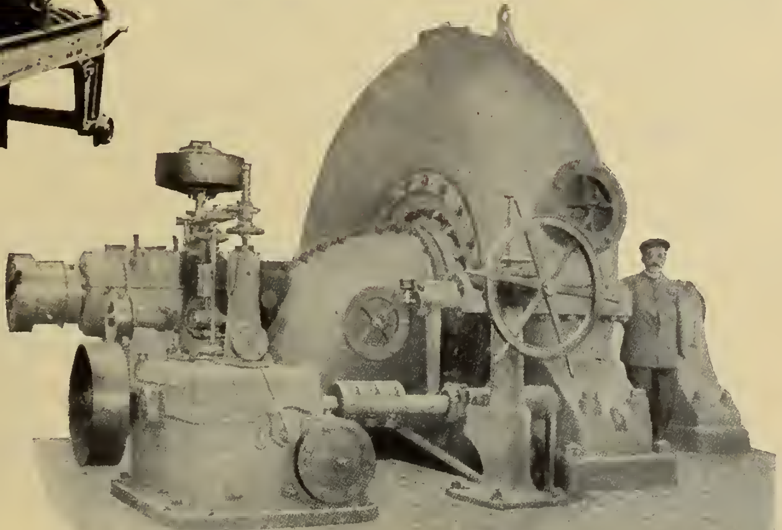

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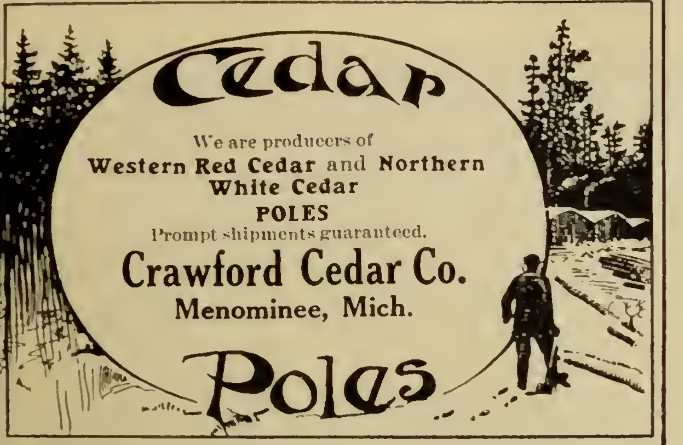

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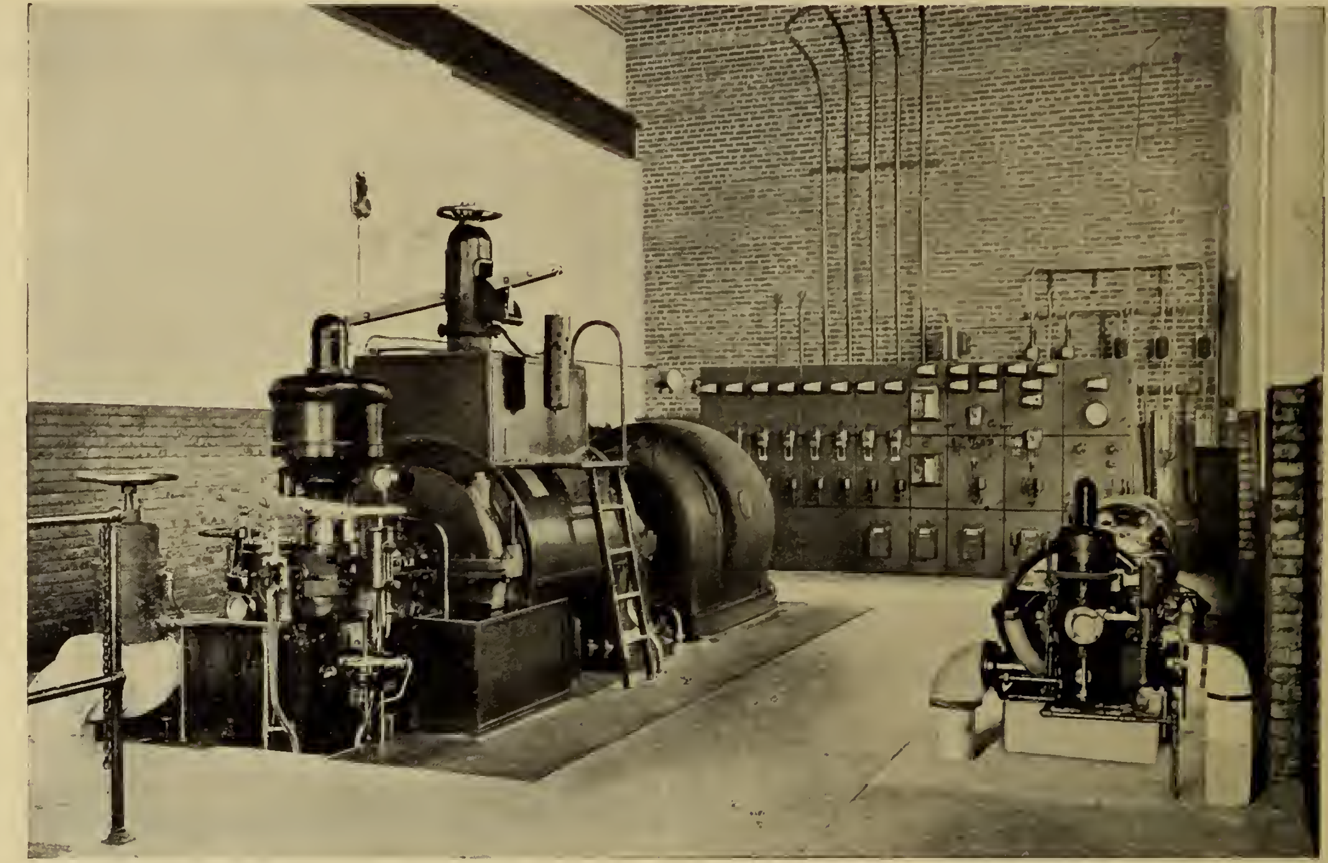

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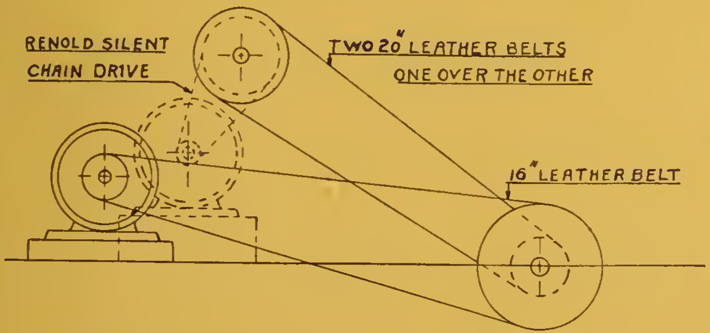
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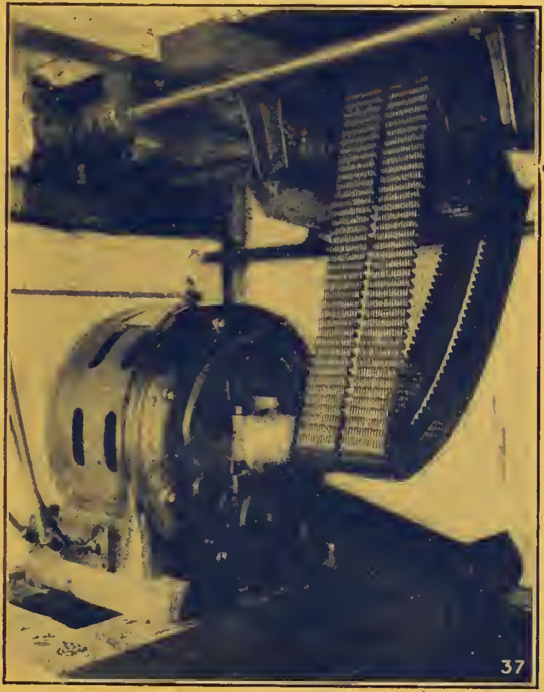

The Renold Chain Drive as shown in drawing opposite.

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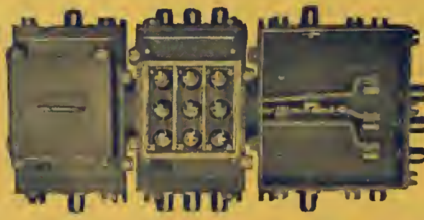

June 15, 1914

Electrical News

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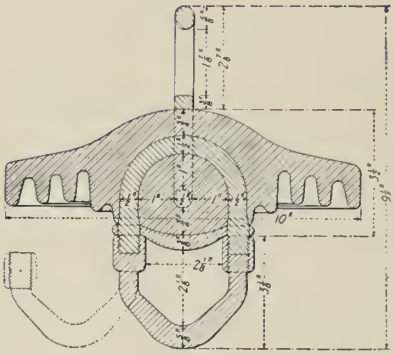

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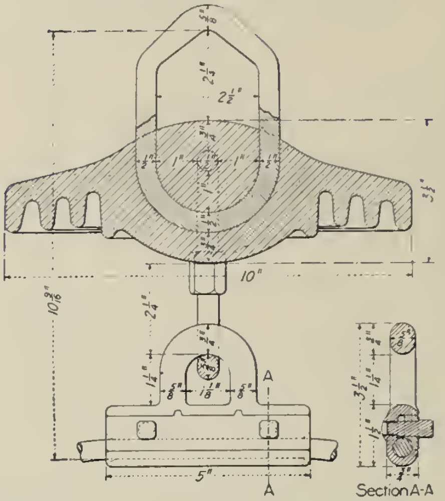

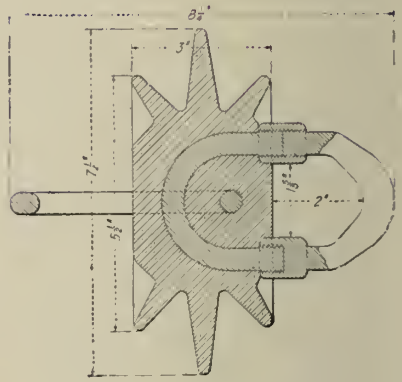

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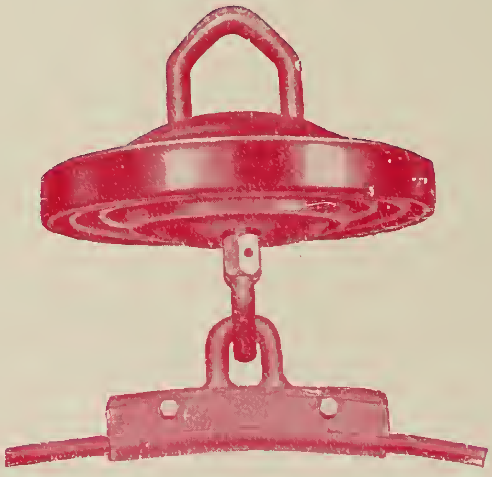

No. 9302

N0. 9302
10-inch Suspension Line and Strain Insulator

Puncture Value	150,000 volts
Dry Arc	10,000 "
Tested to Dry Arc	100,000 "
Rain Arc	55,000 "
Line Voltage	25,000 "
Weight	11 lbs.

No. 162
7 1-2 Inch Disk Strain Insulator

Puncture Value	120,000 volts
Dry Arc	100,000 "
Tested to Dry Arc	75,000 "
Rain Arc	55,000 "
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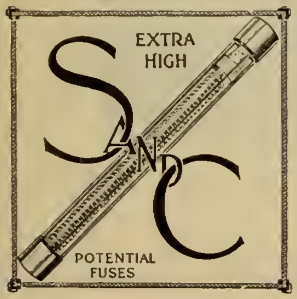

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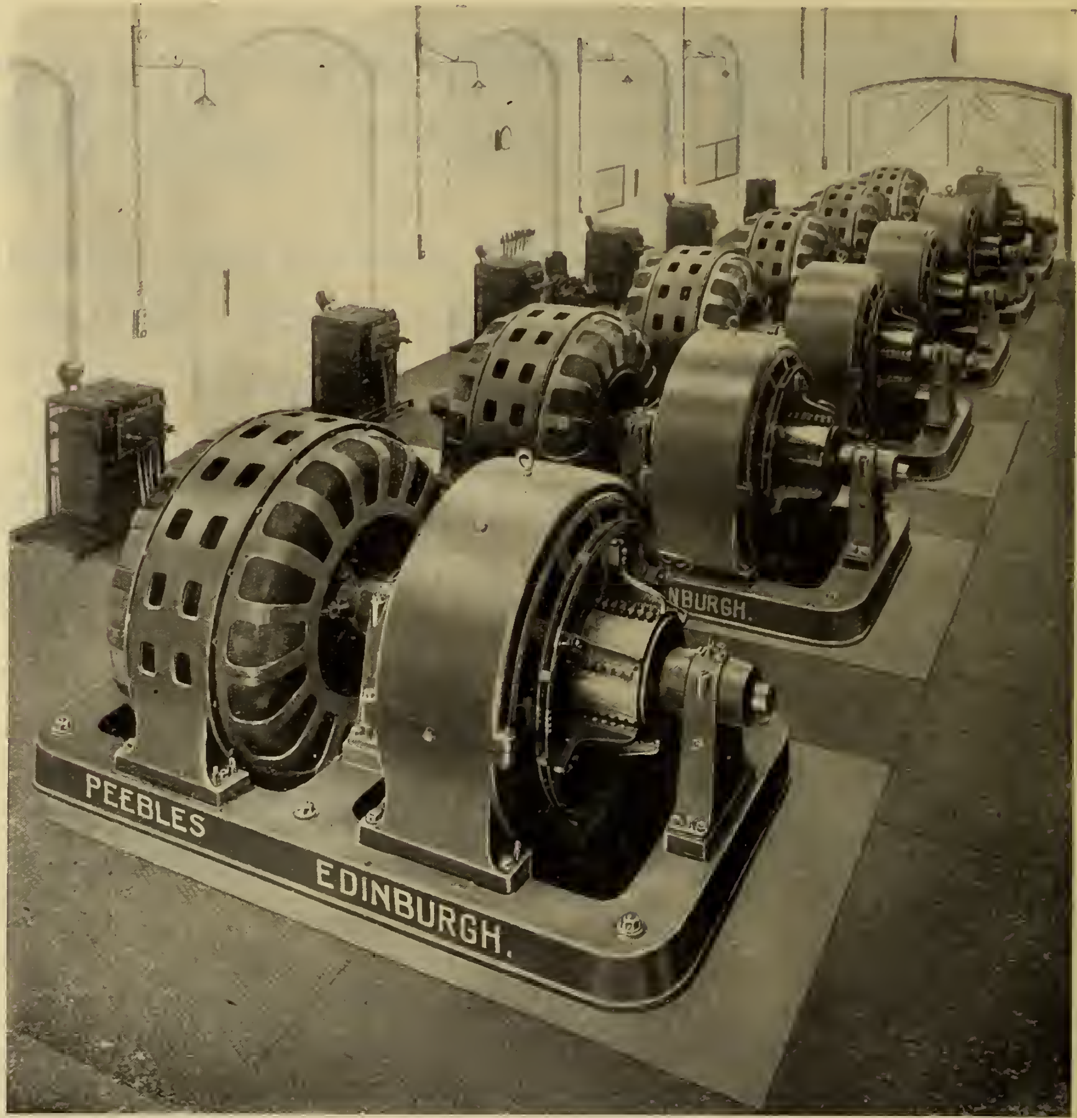

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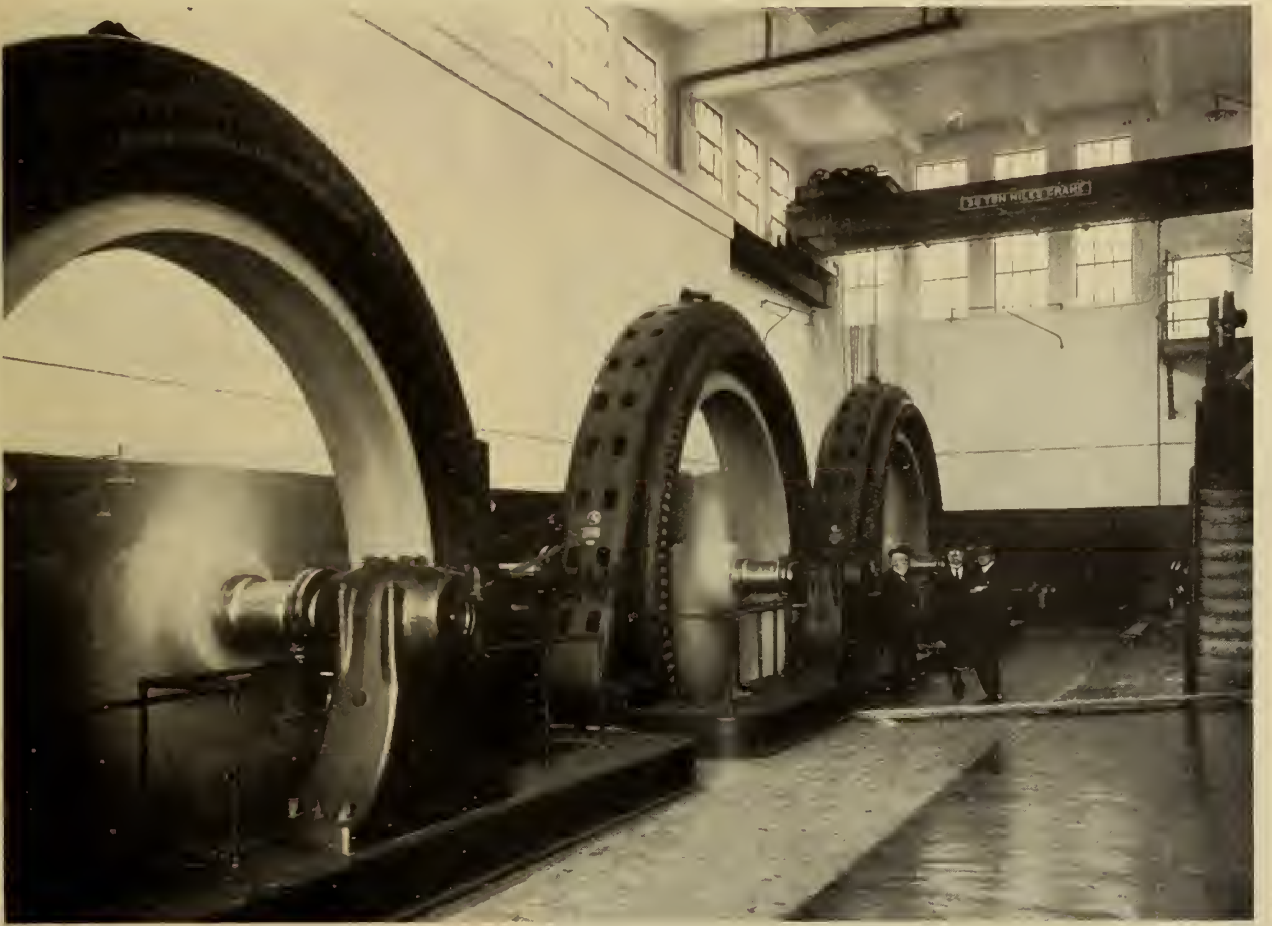

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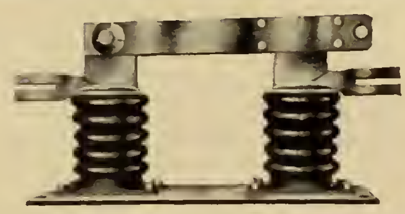

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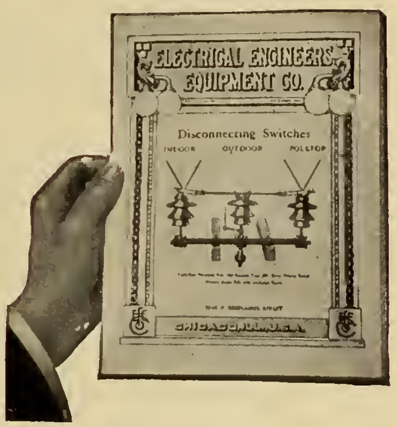

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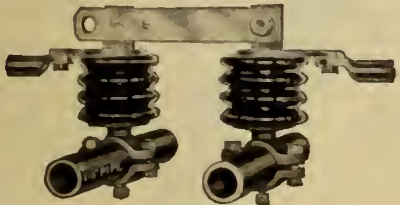

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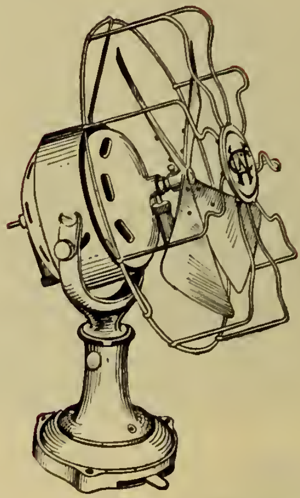

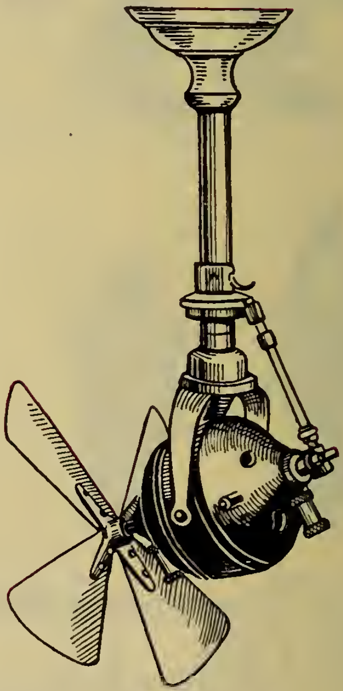

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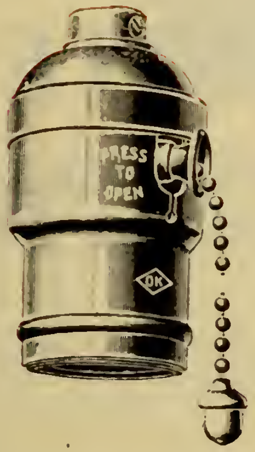

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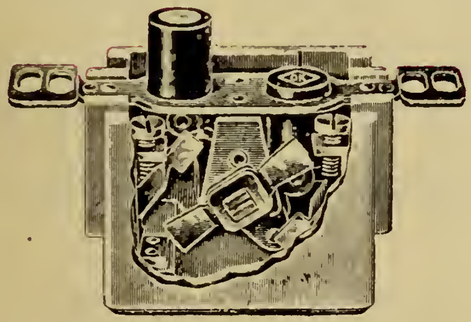

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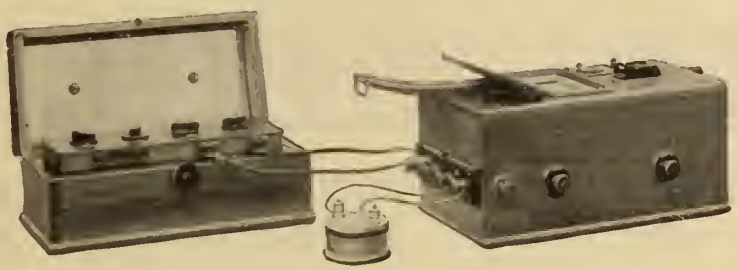
EVERSHED'S
Bridge-Megger Testing Set



The "Megger" Set has become the instrument universally used for insulation measurement, because a "Megger" test is a complete diagnosis of the condition of the insulation. It indicates and discriminates between low resistance due to dust, to damp, to conducting particles embedded in the material, and it shows if the insulation is likely to disintegrate under stress.

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Any test which can be carried out by an ordinary bridge can be performed far more quickly and simply by a "Bridge-Megger" Set, with the additional advantage that the latter is instantly available for insulation tests at high pressure.

Evershed's "Megger" for Testing Insulation Resistance

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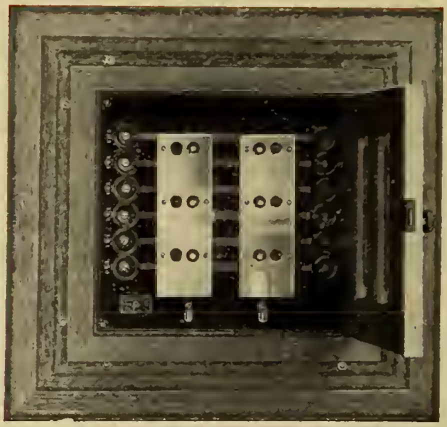
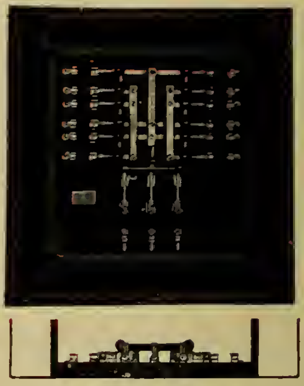
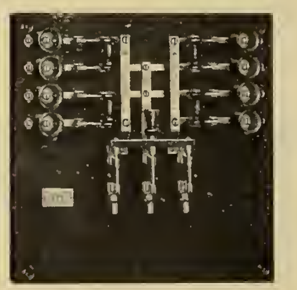


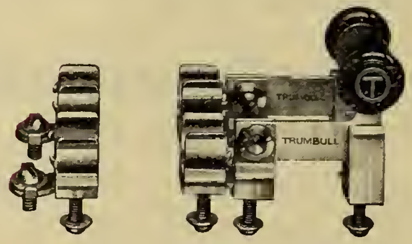
Push Panel and Cabinet —door open



Panel and Box



Type PS for Plug Fuses



Showing Panel Switch (fusible)

Type "T" with Snap Switches

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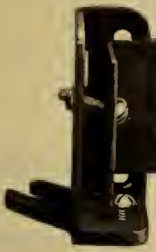
TRUMBULL FEATURES

SWING CLAMP — The adjustable feature of our trim by means of a Swing Clamp in place of screws is noteworthy. (See cut). This permits interchange of Trims of same size and allows for adjusting a reasonable amount of deviation from perpendicular in installing box.



ADJUSTABLE CORNER IRON —(See Cut) Panel and Slate Frame are fastened together as a unit and the slot in the foot of the Corner Iron allows the Panel and Frame to be adjusted to Trim irrespective of box. This adjustable Corner Iron with our adjustable trim gives us adjustable features no others have.

SLOTTED FRAME—The Slate Frames instead of being drilled are Slotted on the bottom so that wires can be connected and the Frame then set down over the wires saving a great deal of time as Frames are not in position and interfering with terminals while connections are being made.

PATENTED CONDUIT HOLE CLOSER—The drilling of holes larger than ½ inch on the job is a tedious proposition so we regularly equip all Boxes for Standard Panels with one Conduit Hole Closer as illustrated in cut. By loosening two screws and placing the proper half circles together, the box may be arranged for ¾ in., 1 in., 1¼ in., or 1½ in. steel conduit, or the hole may be closed entirely by placing blank ends together.

KNOCKOUTS—One end of each box is provided with a Conduit Hole Closer (see note above) and from four to eight knockouts for ½ in. steel conduit. The other end is equipped with as many knockouts as the greatest number of circuits on a Panel that box will hold, i.e., a box that will hold a 10-circuit panel has 10 knockouts, etc. Extra knockouts 2c each net.

THE TRUMBULL ELECTRIC MFG. CO.

PLAINVILLE, CONN.

NEW YORK	CHICAGO	BOSTON	PHILADELPHIA	SAN FRANCISCO
114-118 Liberty St.	15 S. Desplaines St.	76-78 Pearl St.	138 N. 10th St.	84-88 Second St.

1/4 to 40
HORSE POWER

25 to 140
CYCLES

Century

SINGLE PHASE MOTORS

Possess an ability to keep-a-running under unusual conditions which has caused a constant increase in their popularity among Central Station Operators all over the world.

If you do not know all about them let us know.

CENTURY ELECTRIC COMPANY

19th, Olive to Pine Sts., **St. Louis, Mo.**

Stock Carried in Canada by:

Jones & Moore Electric Co., Ltd.,
294-300 Adelaide St. West
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Rudel-Belnap Machinery Co., Ltd.
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VANCOUVER, B.C.

Mainer Electric Co., Ltd
Edmonton, Alta.
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Sell Your Exhaust Steam

FOR heating—stores, offices, churches, schools, public buildings, apartment houses, residences, etc., instead of condensing during the cold winter months.

Our system of installing the underground steam mains is the result of over 37 years of constant study. The transmission loss is reduced to a minimum by carefully covering the pipes, fittings, etc., with our standard insulation.

Let us show you how your "NET PROFIT PER DOLLAR INVESTED" in your Electric Light and Power Plant can be increased.

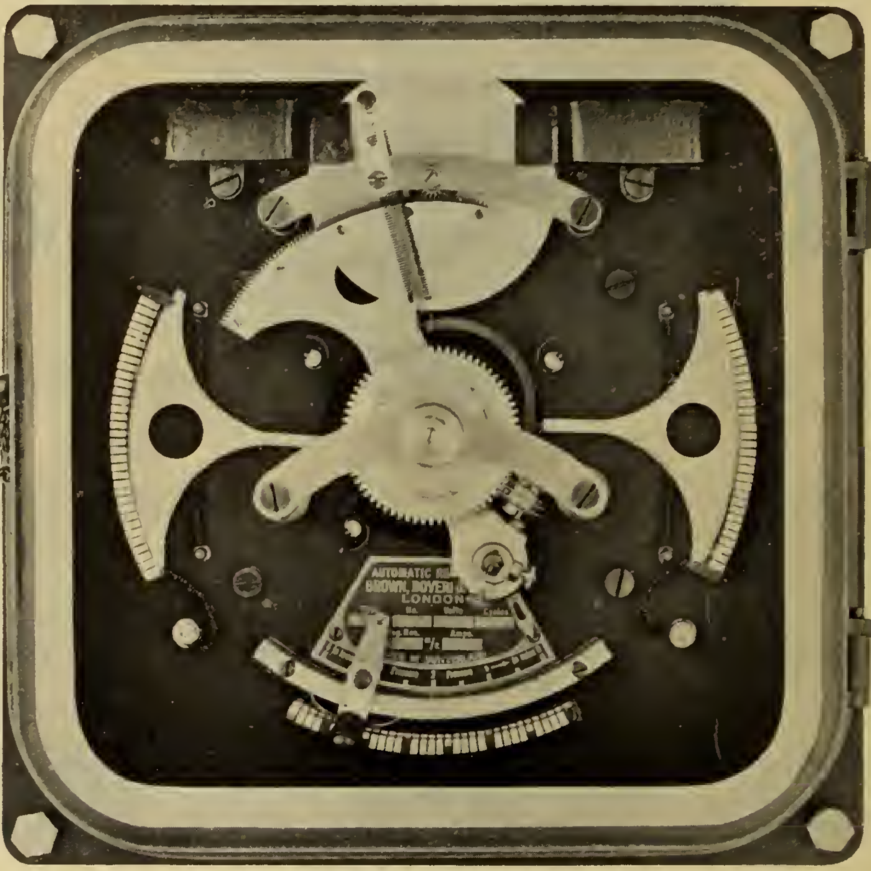
Write today for our bulletins and book "Central Station Heating." They are free.

American District Steam Co.

General Offices and Works
North Tonawanda, N.Y.

Chicago -:- **Toronto** -:- **Seattle**

BROWN BOVERI
AUTOMATIC VOLTAGE REGULATOR



Is the voltage regulation of your plant satisfactory?

How Much Does It Cost You?

For attendance at rheostat hand-wheels? For lamps burned out by too high voltage? In other ways, due to bad voltage regulation?

If you have never considered this matter, now is the time. A Brown Boveri Automatic Voltage Regulator will eliminate all this expense.

Write for particulars to

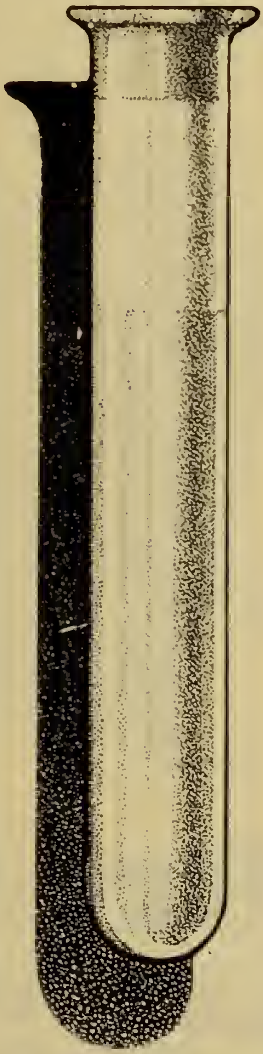
THE CANADIAN
CROCKER-WHEELER CO.
LIMITED
MANUFACTURERS AND ELECTRICAL ENGINEERS

Head Office and Works
ST. CATHARINES

District Offices
MONTREAL, TORONTO, VANCOUVER

CUTLER-HAMMER

The Cream will rise to the top



Fill a test tube with milk, fresh from the cow, and you cannot (by merely looking at the contents of the tube) distinguish the cream from the milk. Let it stand a while and the line of demarcation becomes clear. The cream will rise to the top.

Fill the Test Tube of Trade with a dozen or with a hundred lines of competing apparatus, more or less alike in appearance, and you cannot tell by merely looking at these products of the various manufacturers which is the best. But in this case also, the cream in time will rise to the top.

For a number of years the electric controlling devices designed and built by the Cutler-Hammer Mfg. Co. of Milwaukee have occupied an enviable position at the top of the test tube. Other makes of controllers resemble Cutler-Hammer controllers in appearance, some of them have the prestige of well-known names and unlimited resources back of them, but although there are today some thirty concerns in this country manufacturing electric controlling devices, the fact remains that six out of every ten controllers installed in the United States are Cutler-Hammer controllers.

For twenty years we have built controlling devices and nothing else. We have not attempted to build all kinds of electrical apparatus, but have everlastingly concentrated on one line—controllers—and the men who buy controllers and use them have discovered that there is a difference between Cutler-Hammer controllers and the various other makes that are on the market.

Cutler-Hammer controllers, as a rule, cost a little more than other kinds, so it must be that quality, not price, is the deciding factor with the majority of purchasers. Most people are willing to pay somewhat more for cream.

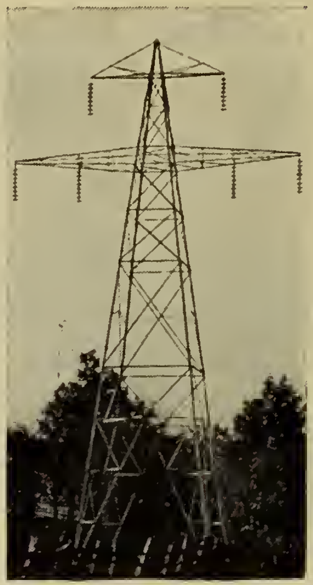
THE CUTLER-HAMMER MFG. CO. MILWAUKEE

NEW YORK: 50 Church Street **CHICAGO:** Peoples Gas Bldg. **PITTSBURG:** Farmers' Bank Bldg. **BOSTON:** Columbian Life Bldg.
PHILADELPHIA: 1201 Chestnut Street **CLEVELAND:** Schofield Building **CINCINNATI:** Fourth Nat'l Bank Bldg.
PACIFIC COAST AGENT: H. B. Squires Co., 579 Howard St., SAN FRANCISCO, San Fernando Bldg., LOS ANGELES
and Morgan Building, PORTLAND, ORE.

Transmission Towers

Hot Galvanized or Painted

Estimates furnished on application



DOUBLE CIRCUIT TOWER

One of 3,300 Towers, furnished for the 300 mile Transmission Line of the Hydro Electric Power Commission of Ontario. Transmitting a 110,000 volt current from NIAGARA FALLS to the principal cities of ONTARIO. The largest single order of Transmission Towers ever placed.

The Canadian Bridge Co.

Limited

Walkerville, Ontario, Canada

MANUFACTURERS OF

Steel Railway and Highway Bridges

Structural Steel of all kinds

The Ohio Brass Co.
Mansfield, Ohio
B
CATALOGUE
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No practical Railway or Transmission man can afford to be without this big handsome volume of live data.

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Mansfield, Ohio, U. S. A.
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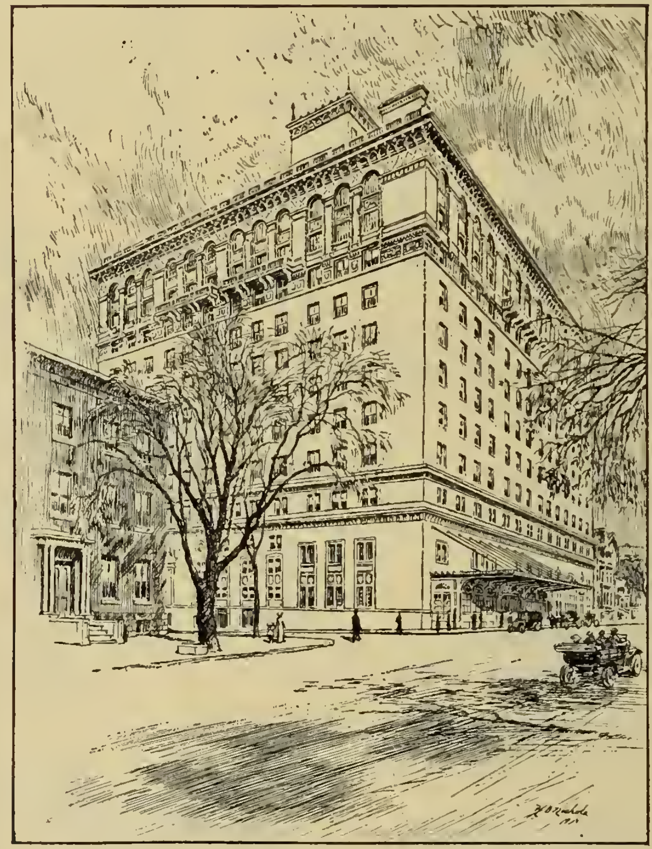
MONTREAL



Wired by the Northern Electric Co., Limited, with

"Imperial Higrade"

RUBBER INSULATED WIRE

Standard of practice for the designers and builders of practically every high grade hotel in Canada.

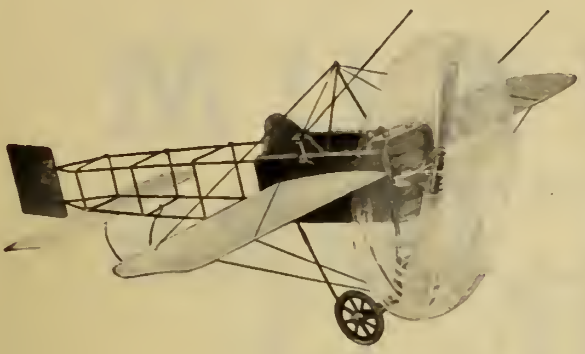
"We'll meet you here on June 24th"

Northern Electric Company
LIMITED

Montreal Halifax Toronto Winnipeg Regina Calgary Edmonton Vancouver Victoria

Successors to IMPERIAL WIRE & CABLE CO., LIMITED.

Correspondence previously addressed to Imperial Wire and Cable Co., Limited, at 611 C.P.R. Building., Toronto, and 902 Electric R. Chambers, Winnipeg, should now be addressed to the Northern Electric Company, Limited, Simcoe St., Toronto, and 599 Henry Ave., Winnipeg.



Miniature Electric Aeroplane

A very popular toy and an exceptionally attractive store window display. Operated on 4 to 8 dry batteries, or on A. C or D. C. lighting circuit, with toy transformer or voltage reducer. Made entirely of metal—planes have spread of 22 inches. Makes a very realistic flight—starting from the floor and landing when current is turned off.

List Price, $9.00

Toy Transformer

The only live parts which are exposed are two binding posts to which small toys, etc., can be connected. There is absolutely no danger from shock with this transformer. Primary voltage, 100 to 125.

Secondary voltage, 3, 6, 10, 15, 20, thus giving 5 different speeds to motor. Voltage is controlled by lever on top of transformer, all contacts are inside.

List Price, complete with 6 feet of cord and attachment plug, $6.50.

Rittenhouse "Easy Lite"

By using this attachment a Key Socket may be readily converted into a Pull Socket.

It is substantial and durable, consisting of but three main parts; a slotted grip, which slides on to the key, a ratchet, and a counter-balanced arm, to which is attached 9 inches of silk cord. The ratchet makes it possible to turn the light ON or OFF WITH A PULL OF THE CORD.

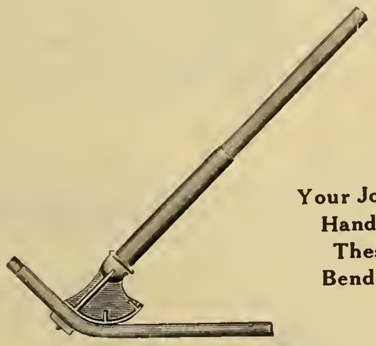
It is made of brass and is dipped and lacquered.

List Price, 15 cents.

Rittenhouse Adjustable Conduit Bender

(May also be used for Metal Moulding)

Is open on one side—has two hardened steel points, preventing conduit from slipping. Adjustment from one size of conduit to another made in 15 seconds. Curved bending bed (3½-in. radius) will not kink conduit. The Rittenhouse Adjustable Bender saves time—it is guaranteed to stand all kinds of hard usage. Sold with or without handle—a short piece of 1¼ in. pipe serves the purpose.



Your Jobber Handles These Benders

Write for booklet and discounts.

A. E. Rittenhouse Company

Honeoye Falls, N. Y.

ALUMINUM CONDUCTORS

Transmission Lines
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Ingots, Sheets, Castings,
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Nipissing Power Company, Limited, North Bay, Ontario.
Seymour Power & Electric Company, Ltd., Campbellford, Ont.
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Complete information on request

Northern Aluminum Co.

Limited

1305-6 Traders Bank Bldg. - Toronto, Ontario

G. M. Gest

Conduit
Engineer & Contractor

Power Building,
Montreal, Canada

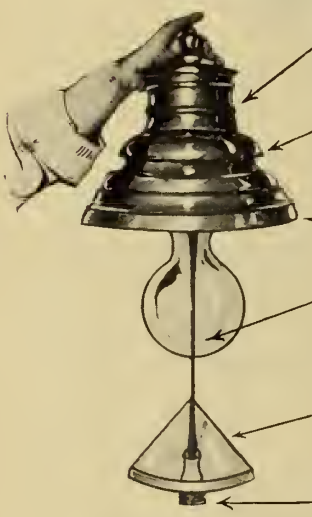
STREET LIGHTING

WITH THE NEW

NITROGEN LAMPS

POLE TOP TYPE

(Patent Pending)



No. 1.—Adjustable Socket, **suits any size lamp.**

No. 2.—Perfect Ventilation, insures **long life** of lamp.

No. 3.—Reflector properly directs light.

No. 4.—Strong single support, **minimum shadow.**

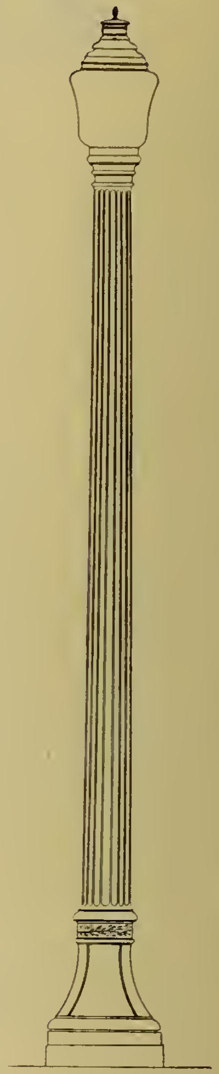
No. 5.—Bottom Reflector.

No. 6—Mogul Plug, **permitting the entire unit to be easily screwed into position.**

No. 7.—Glassware, correct design with high diffusing and non-absorbing properties.

SERIES OR MULTIPLE

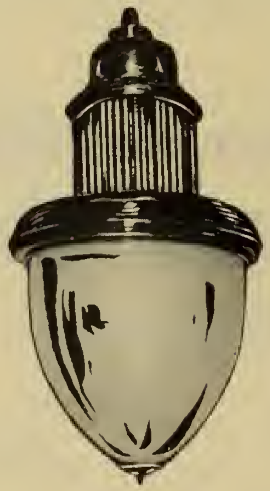
Excellent Appearance



Note Features of the Pendant Type—

- **Rugged Construction** ☞
- **Perfect Ventilation** ☞
- **Any Size of Lamp** ☞
- **Perfect Glassware** ☞

SERIES OR MULTIPLE



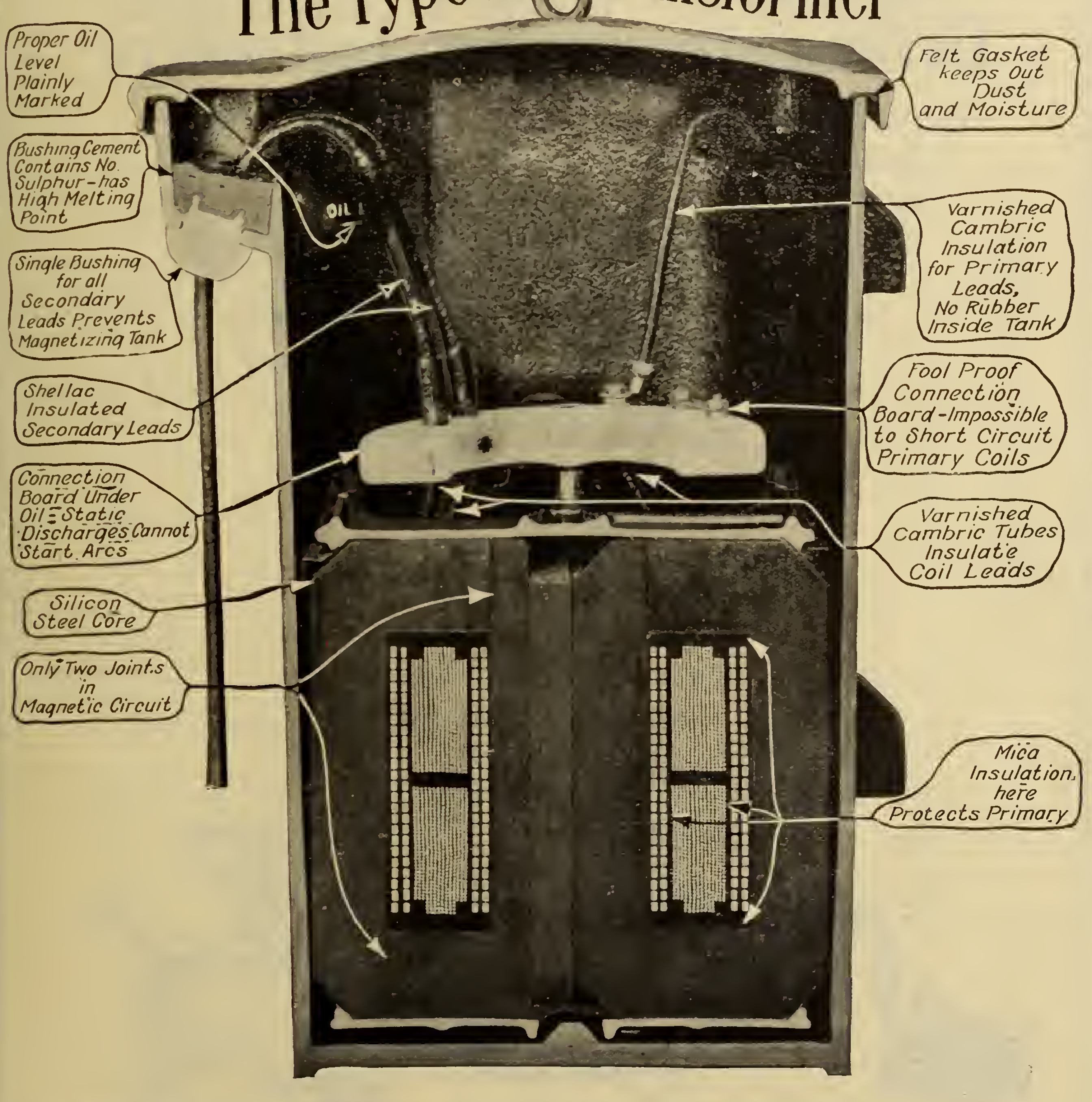
Pendant Type

Write for prices and particulars.

A. H. Winter Joyner
Limited
76 Bay Street
Toronto

"Consult a Specialist"

Look Inside
The Type H Transformer


Proper Oil Level Plainly Marked
Bushing Cement Contains No. Sulphur - has High Melting Point
Single Bushing for all Secondary Leads Prevents Magnetizing Tank
Shellac Insulated Secondary Leads
Connection Board Under Oil - Static Discharges Cannot Start Arcs
Silicon Steel Core
Only Two Joints in Magnetic Circuit
OIL
Felt Gasket keeps Out Dust and Moisture
Varnished Cambric Insulation for Primary Leads, No Rubber Inside Tank
Fool Proof Connection Board - Impossible to Short Circuit Primary Coils
Varnished Cambric Tubes Insulate Coil Leads
Mica Insulation here Protects Primary

CANADIAN GENERAL ELECTRIC CO.
LIMITED

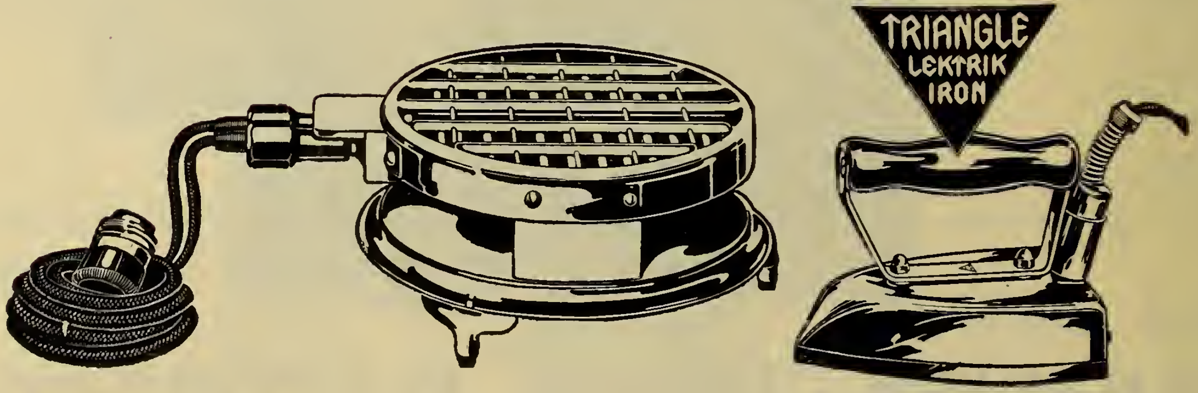
Manufacturers of Electrical Apparatus and Supplies
for Railway, Light and Power Purposes

Head Office: Toronto. District Sales Offices: Montreal, Halifax, Ottawa, Cobalt, Porcupine, Fort William. Winnipeg, Regina, Saskatoon, Calgary, Edmonton, Nelson, Vancouver, Victoria, Prince Rupert.

These "Triangle Lektrik"

Devices are your two best sellers

Because they are high in quality, low in price, have a superior look and finish, give absolute satisfaction, have their heating elements guaranteed for all time, by the largest, oldest and most reputable exclusive makers of heating devices in the world. Because we recommend them and help you reach the big market for these appliances which is right in your own neighborhood are reasonable reasons why you should write our nearest house **today** for best prices and information regarding selling helps.



Northern Electric Company
LIMITED

MONTREAL WINNIPEG EDMONTON HALIFAX REGINA
VANCOUVER TORONTO CALGARY VICTORIA

Bryant Flush Devices

The Celebrated "D. D." and "Chapman" Receptacles
and "Perkins" One and Two Button Push Switches.

The "D. D." Receptacles.

Have automatic doors which close when the plugs are withdrawn covering up all live parts.

Have ribs on the doors which take the wear and hold the plugs securely in place.

Have metal covered indestructible plugs which may be finished to match the plates.

Have plates with spring hinges which causes a "quick break" when the plugs are withdrawn.

Are made in two sizes, the smaller, fitting any standard shallow outlet box, for service not requiring over 10 amperes, 250 volts, the larger requiring two gang boxes, for use when the requirements exceed 10 amperes, 250 volts, as with luminous radiators, portable tools, moving picture machines, stereopticons and stage receptacles.

The "Chapman" Receptacle.

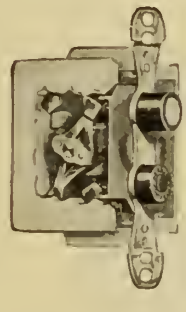
Low priced, only $1.15 list with plate and porcelain plug.

Can be furnished **with indestructible** plugs made of composition at an advance of 20 cents.

Doors close whether plug is inserted or not.

The Receptacle with a fifteen years' reputation behind it

The Two Button Push Switch



Has a short light action. Is fitted with a fibre shield protecting the interior.

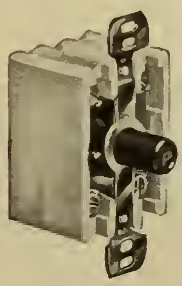
The corners of the porcelain are chamfered, making the switch easy to wire and preventing unnecessary breakage.

The binding screws have long threads and large heads.

The escapement is operated by a separate spring from that controlling the mechanism.

The operating parts are mounted on the porcelain and are entirely insulated from the yoke, making a ground or short circuit impossible.

The Single Button Push Switch.



Can be provided for any of the purposes for which surface snap switches only, were formerly available.

The buttons are always "out."

When installed in gangs the switches always present a uniform appearance.

When so ordered, indicators are provided showing at a glance whether the current is on.

Carried in stock by

Northern Electric Company

LIMITED

MONTREAL HALIFAX TORONTO WINNIPEG REGINA
CALGARY EDMONTON VANCOUVER VICTORIA

McEWEN ENGINES

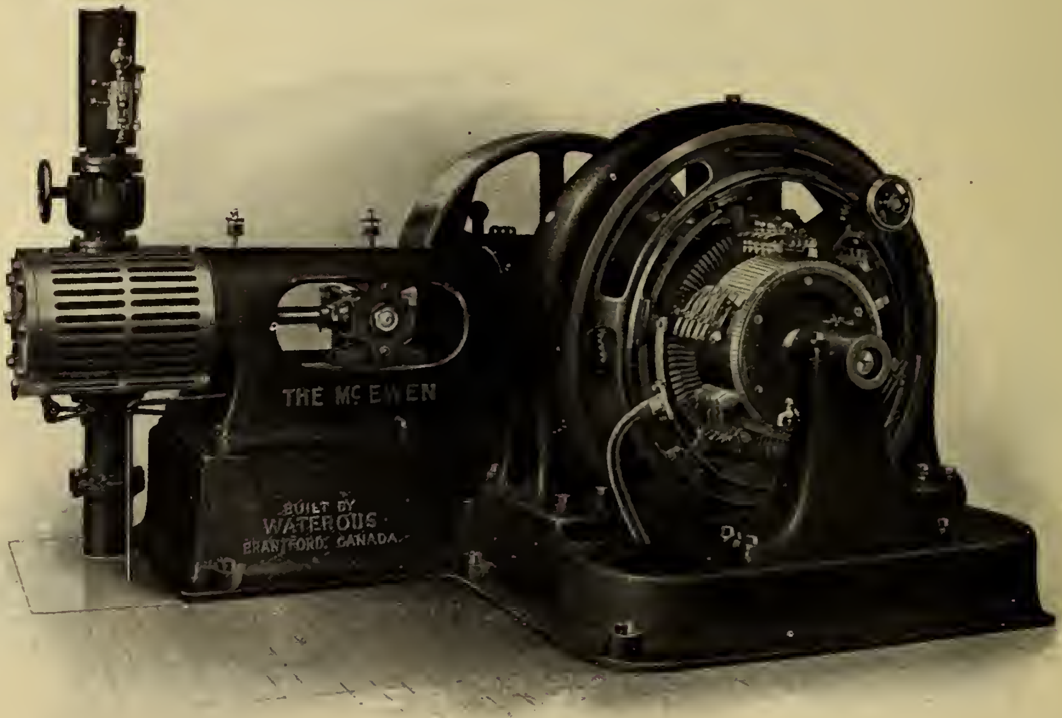
FOR ISOLATED PLANT USE

A McEwen in your Engine Room means economical power—and lots of it—all the time. Every dollar you put into your McEwen Engine you take out in continuous satisfactory, seven-day-in-the-week service.

Smooth, powerful, easy-running McEwen Engines improve with use. They are sold on a reputation for economy and efficiency, and are built and designed to **maintain** it year after year.

Hundreds of users in Canada will testify to this.

Our McEwen booklet is compact, well illustrated and interesting. It tells you what you want to know about McEwen Engines. Write for it.



THE WATEROUS ENGINE WORKS CO., LIMITED
BRANTFORD - CANADA

The Telephone Business Is Our Only Business

We manufacture everything in the way of telephones—**Common Battery Telephones** for manual exchanges, **Automatic Switchboards and Telephones** for town and city installations, **Magneto Telephones and Switchboards for rural lines,** and the **Presto-Phone,** an automatic telephone system for use in factories, departmental buildings, etc.

All our equipment is most up-to-date in design, and of guaranteed quality.

We have telephone specialties, such as the Phone-Eze Bracket, which takes the telephone off your desk and places it out of the way, but always at hand for use; The Flint Sanitary Mouth Piece, the latest and best on the market; Writing Pads for desk or wall telephones.

Write us for information in regard to any of the above. Literature will be gladly sent.

Canadian Independent Telephone Co. Limited

Duncan Street, Toronto

FANS

The Warm Weather is Here—are you prepared for it?

Last minute call for fan orders for immediate shipment. All standard sizes carried in stock together with a complete assortment of extra parts.

LAMPS

"CONDOR" Tungsten Lamps.

We are sole Canadian distributors for this well known, guaranteed lamp. If not a "Condor" dealer get our latest special prices and conditions. Stock carried in Toronto in all standard sizes from 10-500 watts.

ELECTRIC FIXTURES

Watch for our special announcement of high-grade, hand-made electric fixtures. This line will be a money-maker for the dealers, comprising exclusive and original designs.

Get our quotations on fixtures made from your own original designs.

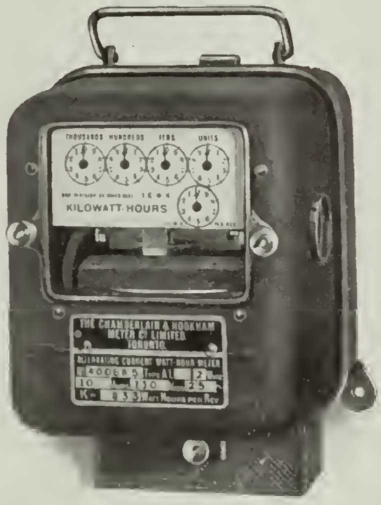
C. H. BASTERS & COMPANY

TORONTO 22 College Street CANADA

Every Central Station Man

knows that defective meter service is disastrous to any power system. He knows how quickly the profits can be eaten up by "leaky" meters. He also realizes that continued "kicks" coming in from customers whose meters are over-registering plays havoc with the reputation of a power company and eventually is the cause of many lost patrons.

In view of these and many other reasons is it not worth while having **good, reliable, accurately registering** meters on your lines?

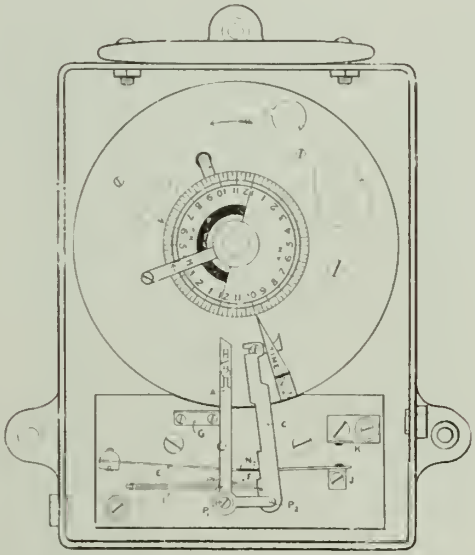


SINGLE PHASE METER.

The VENNER

The KING of Time Switches

We illustrate here the working details of our Type "B" time switch which is particularly adapted for controlling two-rate meters, store, stair-case or street lighting. Other types for all currents up to 600 amperes and 4000 volts.



Time Switch

The Switch that does Everything—except Fail

The clock has a fully jewelled lever escapement, including jewelled pallets and a Breguet hair-spring. The movement is non-magnetic, compensated for temperature, completely insulated from switch and runs accurately 45 days on one winding due to fuse drive.

There is no better time switch on the market than the Venner. Get our prices.

POLYPHASE METER

A TONIC FOR UNPROFITABLE SYSTEMS

C & H METERS

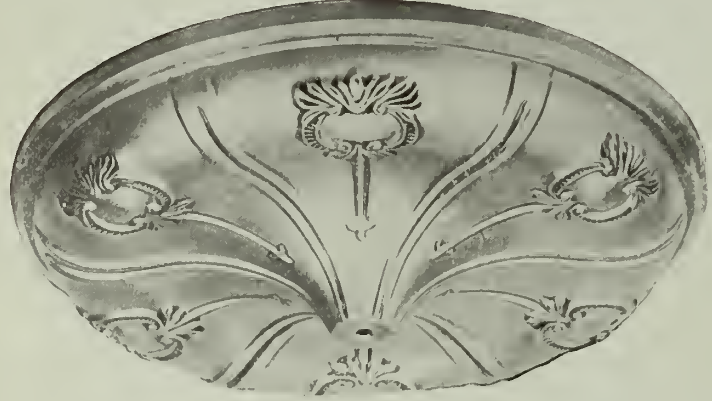
The past performances of **C** & **H** meters have amply demonstrated their ability to give consistent satisfaction over periods of long duration. Let us demonstrate their ability to you.

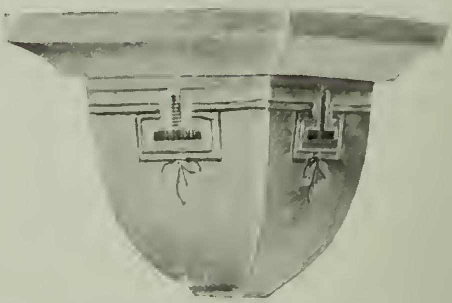
Large stocks of single and polyphase meters carried at Toronto and Winnipeg where we maintain permanent test rooms. This enables us to give you efficient and prompt service.

Try us for a rush order.

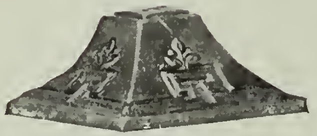
Chamberlain & Hookham Meter Co., Ltd.

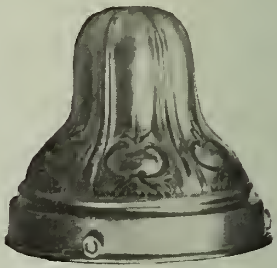
TORONTO 120 Richmond St. W. ONTARIO
WINNIPEG 61 Albert St. MANITOBA
Spencer & Aspinall, 617 New Birks Bldg., Montreal, P.Q.


916—Plate, 12″, 14″ and 16″.


910—Canopy, with or without Slip.

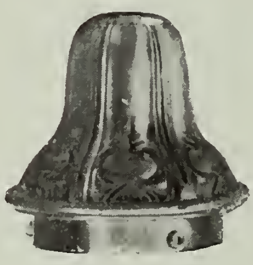
Fixture Men

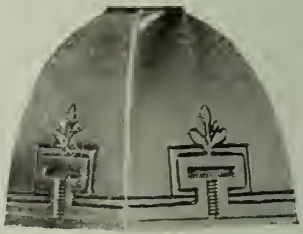

913—Shell.


917—3½″ Fitter.

Your buyers are continually asking the travellers, "Can you give us good goods and prompt shipments." Now if the wholesales and jobbing houses do not carry a large stock of their material on hand, you naturally have to wait for the goods. Did you ever stop to consider that we carry the largest stock in Canada of Electrical Fixture Parts and Fittings, also steel and brass Chandelier Chains, and can give you good goods and prompt deliveries at all times.

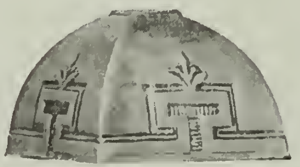
We are illustrating on this page a few of the many designs which we have added to our lines, since the publication of our No. 2 catalogue a few months ago, and are pleased to state that they are meeting with great demand. Do they interest you? If so, write us for cuts and prices—a postal will bring them.

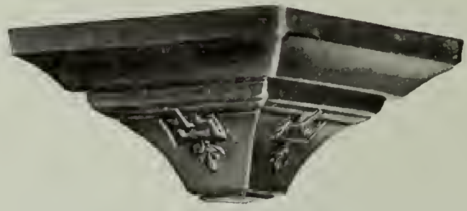

918—2½″ Fitter.

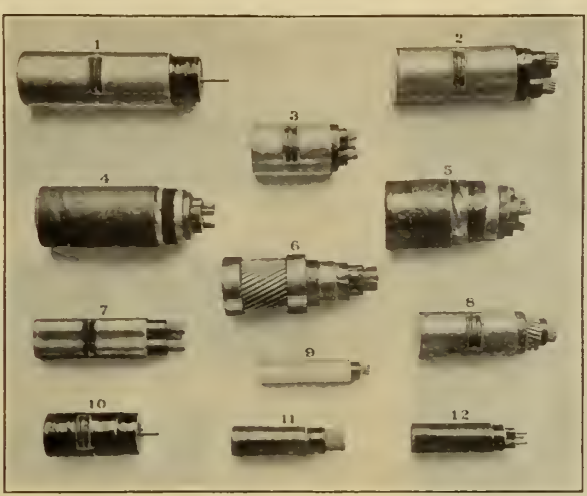

915—Shell

W. H. BANFIELD & SONS

120 Adelaide St. W.
TORONTO, - ONT.


914—Shell.


912—2 pc. Shell.



1, 2—Varnished Cloth Insulated Lead-Covered Cable.
3—Paper Insulated Lead-Covered Cable.
4—Paper Insulated Steel-Tape-Armored Cable.
5—Rubber Insulated Steel-Tape-Armored Cable.
6—Varnished Cloth Insulated Steel-Wire-Armored Cable.
7—Flat Duplex Paper Insulated Lead-Covered Cable.
8—Concentric Duplex Paper Insulated Lead-Covered Cable.
9—Varnished Cloth Insulated Asbestos Covered Cables.
10, 11, 12—Varnished Cloth Insulated Braided Cables.

Our Argument

when thus soliciting your patronage for our products is based principally on these three facts:

First, the superior and sustained quality of STANDARD products;

Second, their great variety which enables us to meet your every requirement in the way of electric wires and cables and their accessories;

Third, our extensive and up-to-date facilities which enable us to meet your emergency demands, shipping promptly from extensive stocks all products not necessarily made to special order.

The following is an outline of our principal products:

Wire Rods
Bare Wire and Cable
Trolley, Line and Transmission Wires
Standard C.C.C. Wire
(Colonial Copper Clad)
Bare and Insulated
Magnet Wire
All sizes shapes and finishes
Weatherproof Wire
All sizes and finishes
Rubber Insulated Wire
For all kinds of service
Varnished Cloth Cable
Braided or Lead-Covered
Fibre Lead-Covered Cable
Telephone and Telegraph Service
Paper Lead-Covered Cable
Dry or Saturated Cores
Rubber Lead-Covered Cable
For all kinds of service
Armored Cable
Steel-Wire and Steel-Tape-Armored
Cable Terminals
(D. O. A.) Outdoor,
(D. S.) Indoor Service
Cable Junction Boxes
For A. C. or D. C. Systems
'Ozite" Insulating Compounds
For Joints, Terminals, Junction Boxes
Insulating Tapes and Sheets
Jointing Supplies
Cable Hangers and Supports

Cable Installations

Detailed information, samples, estimates or prices of any of the above products will be cheerfully and promptly supplied upon request to our nearest office.

Standard Underground Cable Co., of Canada, Limited

Hamilton, Ont.

Montreal, Que. Boston, Mass. Seattle, Wash. Winnipeg, Man.

MOLONEY
Efficiency

Cool transformation every day and all day long with a minimum of core and copper loss are the qualities that constitute transformer efficiency. In Moloney Transformers the cores are of Silicon Steel which is the best known material for this purpose. The use of this metal has reduced core losses to almost nothing.

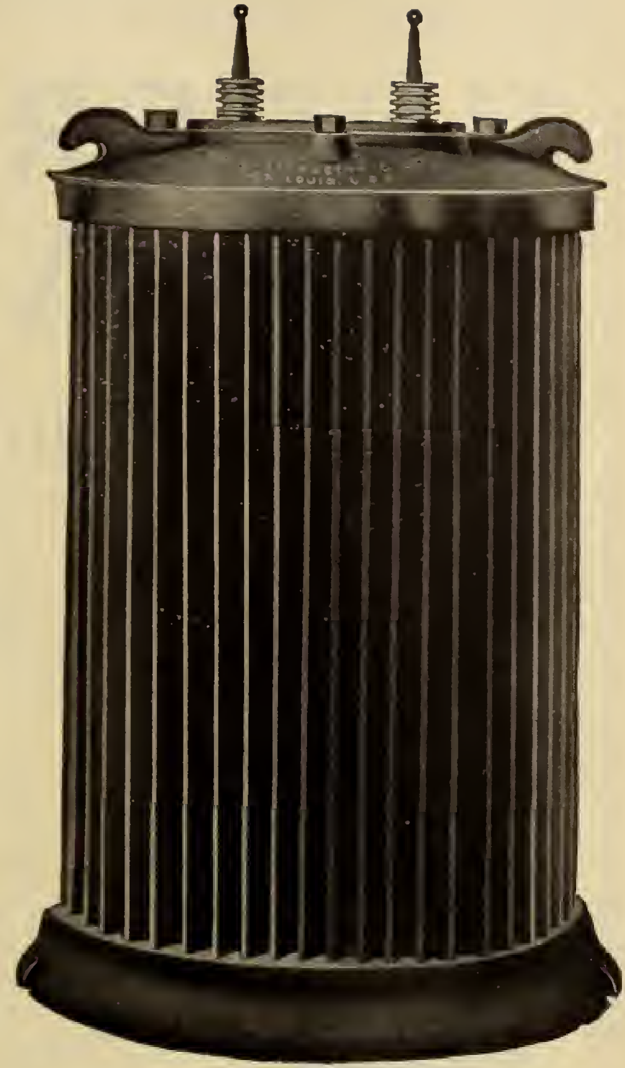
Moloney transformers are made in every size, water-cooled, oil-cooled or air-cooled.

Moloney Electric Company
of Canada, Limited
Windsor, Ontario

Factories at Windsor, Ont., Can. and St. Louis, Mo., U.S.A.

901 Electric Railway Chambers, Winnipeg, Man., Can.
1001 C. P. R. Building, Toronto, Ont., Can.
401 Lake of the Woods Building, Montreal, Quebec, Can.
221 Rogers Building, Vancouver, B. C., Can.

Complete Stocks at Windsor, Winnipeg. Calgary, Vancouver



MOLONEY

Simplicity

As a specialized factory making only transformers we are able to produce a transformer that will operate more economically than any other make on the market. Simplicity is a feature of Moloney construction.

Our catalogue outlines a simple method of testing the efficiency of transformers. It also contains complete information about Moloney Transformers.

Send for a copy.

Moloney Electric Company

of Canada, Limited

Windsor, Ontario

Factories at Windsor, Ont., Can. and St. Louis, Mo., U.S.A.

901 Electric Railway Chambers, Winnipeg, Man., Can.
1001 C. P. R. Building, Toronto, Ont., Can.
401 Lake of the Woods Building, Montreal, Quebec, Can.
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Complete Stocks at Windsor, Winnipeg, Calgary, Vancouver

UNDERGROUND CABLES

LOW AND HIGH TENSION

FOR LIGHTING,
POWER,
STREET-
RAILWAYS,
TELEPHONE,
TELEGRAPH.

EUGENE F. PHILLIPS ELEC. WORKS LIMITED. MONTREAL.

ARMOURED CABLES FOR STREET LIGHTING, PAPER INSULATED CABLES OF ALL DESCRIPTIONS, RUBBER INSULATED CABLES &c.

Also Bare and Weatherproof Wires and Cables,
Magnet Wire, Flexible Cords, &c.

Galvanized Iron Wire and Strand

HEAD OFFICE:

MONTREAL, CANADA

BRANCHES:

Toronto, Winnipeg, Halifax, Vancouver.

A SAFE ENTRANCE SWITCH

2 Pole, 30 Amp., 125 Volt, Cover Closed, Switch Locked "Off"

Detroit Ironclad Entrance Switches give real protection where it is most needed, by preventing unauthorized persons or those not realizing the dangers of electricity, having access to the current carrying parts of the entrance switch and cutout.

3 Pole, for Edison Plug Fuses

All live parts enclosed.

Cover of switch-box closes by gravity.

Switch operated from outside of box.

Cover can be sealed or locked "shut."

Switch can be locked "off."

For open wiring or conduit.

All types approved.

3 Pole, for Open Link Fuses, Equipped with detachable Handle

Install Detroit Entrance Switches. Remove danger and with it the temptation to be careless. Take safety out of human hands and make it automatic.

Detroit Entrance Switches aid in preventing theft of current by making it impossible to take current from the live parts of the entrance switch and cutout, when the cover of the switch-box is sealed or locked shut.

Bulletin 27 gives detailed information regarding these switches. Send the coupon for your copy now.

Detroit Fuse & Mfg. Co.
1404 Rivard Street, Detroit, Mich., U. S. A.

Bentz-Richardson Co., Ltd.
Winnipeg, Manitoba

McNaughton-McKay Electric Co., Ltd.
Windsor, Ontario

"DO IT ELECTRICALLY"

DETROIT FUSE & MFG. CO.
1404 Rivard Street Detroit, Mich., U. S. A.

Please send Bulletin 27 and detailed information regarding Detroit Ironclad Entrance Switches.

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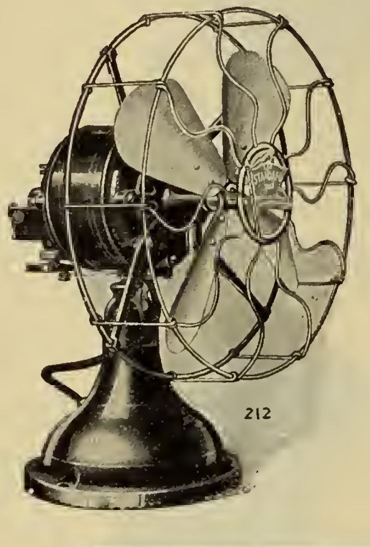
Boost Your Fan and Small Motor Business By Selling The Best



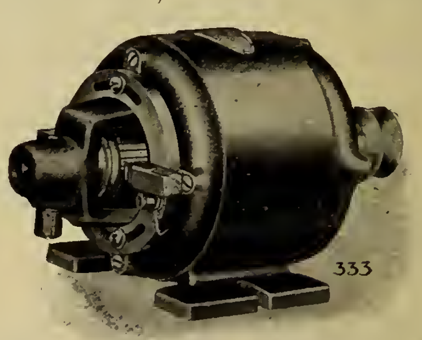
Every fan or motor the dealer sells is a boost for his business, or just the opposite. A quiet, reliable, economical Fan—a reliable, efficient motor will bring dozens of new orders from the friends of your customers.

The dealer who is building for a permanent, growing business can always be sure of results by pushing high quality goods.

Robbins & Myers "STANDARD" Motors and Fans

are guaranteed to give the kind of efficient, reliable service that makes friends and builds business for the dealer.

By devoting our entire attention to small motors and fans alone, we have bee able to attain as near perfection as could possibly be reached. Our engineering force, factory equipment—everything is specialized for the production of small motors, A. C. and D. C. And our experience in this work covers a period of over eighteen years.



We are also prepared to help the dealer sell Robbins & Myers products by an extensive Cooperative Advertising Plan.

Write for details

BY INVITATION
MEMBER OF

NEW YORK U.S.A.

THE ROBBINS & MYERS COMPANY

SPRINGFIELD, O.

THE WORLD'S LARGEST EXCLUSIVE MANUFACTURER OF SMALL MOTORS,
1-60 TO 15 HORSE POWER D.C., AND 1-60 TO 1 H.P. A.C.

Modern Devices

for eliminating existing difficulties

UNIVERSAL BUSHINGS

FOR FLEXIBLE TUBING

No. 1&3 Universal Bushings
Patented

are indispensable for holding flexible tubing securely in switch boxes, cabinets, outlet boxes, and junction boxes. They can be quickly installed without the use of tools by simply slipping over the tubing. These bushings are easily accessible, there being no necessity to dismantle the switch box, and can be removed for inspection without injuring bushing or tubing.

Universal Bushings combine the functions of porcelain bushing and tape and give the job a finished appearance. They are made in four sizes which cover every condition in wiring.—

Nos. 1 & 3 for ⅝ in. knockouts; 7/32 in. & ¼ in. tubing.
Nos. 2 & 4 for ⅞ in. knockouts; 7/32 in. & ¼ in. tubing.

A trial will convince you of the practical qualities of these bushings.

Approved by the National Board of Fire Underwriters.

Samples and prices on request.

No. 2&4 Universal Bushings
Patented

FLEXIBLE TUBING CLAMPS

Type A
Patented

are designed for holding tubing at wall and ceiling outlets where boxes are not used. They do away with nails, staples, tape and other obsolete methods of securing flexible tubing.

These clamps prevent any displacement of the tubing after the work has been inspected.

Type A. For Combination Gas and Electric outlets, the centre opening being for the gas pipe and the outside openings for tubing.

Type B. For straight electric outlets. Invaluable for fastening directly to the Header Board or joist.

Flexible Tubing Clamps are quickly and easily installed and should be back of the plaster line. They are made with round edges to prevent cutting the tubing when bent at an angle to the clamp.

Approved by the National Board of Fire Underwriters.

Type B

Write for prices and samples of these "Money Savers."

New Process Specialty Company, Inc.

MILWAUKEE, WISCONSIN

EUREKA
Vacuum Cleaner

A Light, Powerful
Electric Machine.

Write us for descriptive literature and special proposition to central stations and dealers. :: :: ::

ONWARD MFG. CO.
BERLIN, ONT.

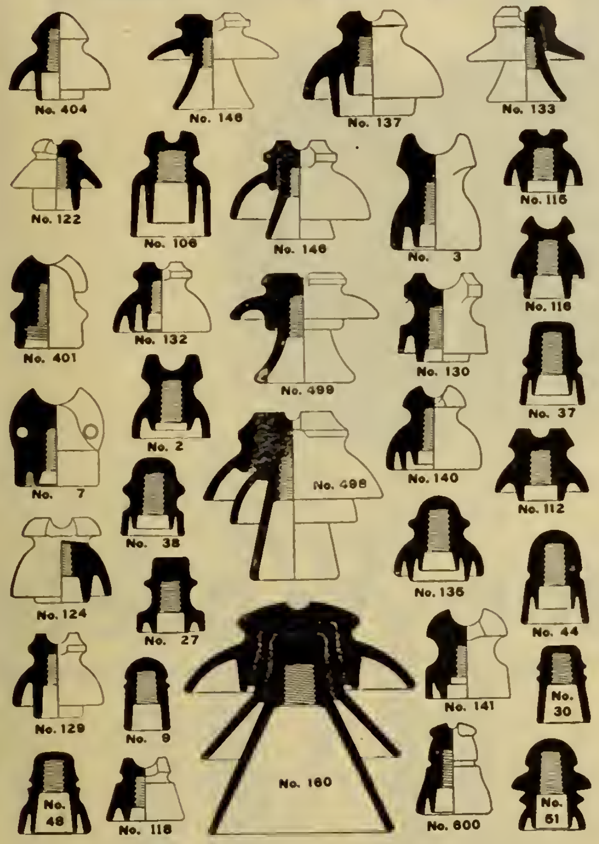
OUR CARLOAD OF
TRUMBULL MATERIAL

We can supply your Switch Requirements from stock

The Mainer Electric Co., Limited, Winnipeg

Which Insulator Interests You?

Drawings below are about 1 9 size.



We will be glad to send a sample insulator to responsible electrical men. Select the one you think will suit. Use the coupon below. We make many more types than shown here and for every insulating purpose, either standard or for your special needs from your blue prints.

STANDARD FOR HALF A CENTURY

.... CUT OR TEAR ALONG THIS LINE ....

BROOKFIELD
REG. U. S. PAT. OFF.
GLASS COMPANY

2 Rector Street, New York
Chicago Office, - - 309 S. Desplaines St.
Factories in Brooklyn, N.Y. and Old Bridge, N. J.
Canadian Representatives, *Northern Electric Company* LIMITED
Montreal, Toronto, Halifax, Winnipeg, Calgary, Vancouver Edmonton

Please send sample of Insulator No.........

I {have / haven't} a copy of your catalog No. 51

Name ....

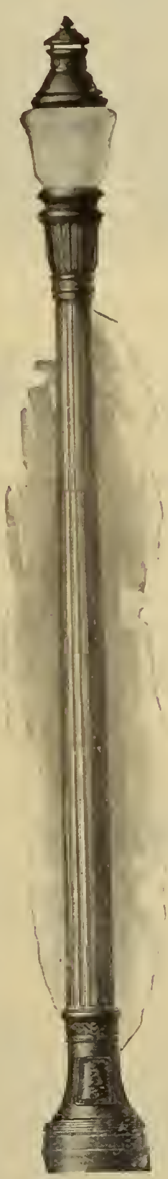
Firm ....

City and State ....

Street ....

E N 23

Ornamental Lighting Poles



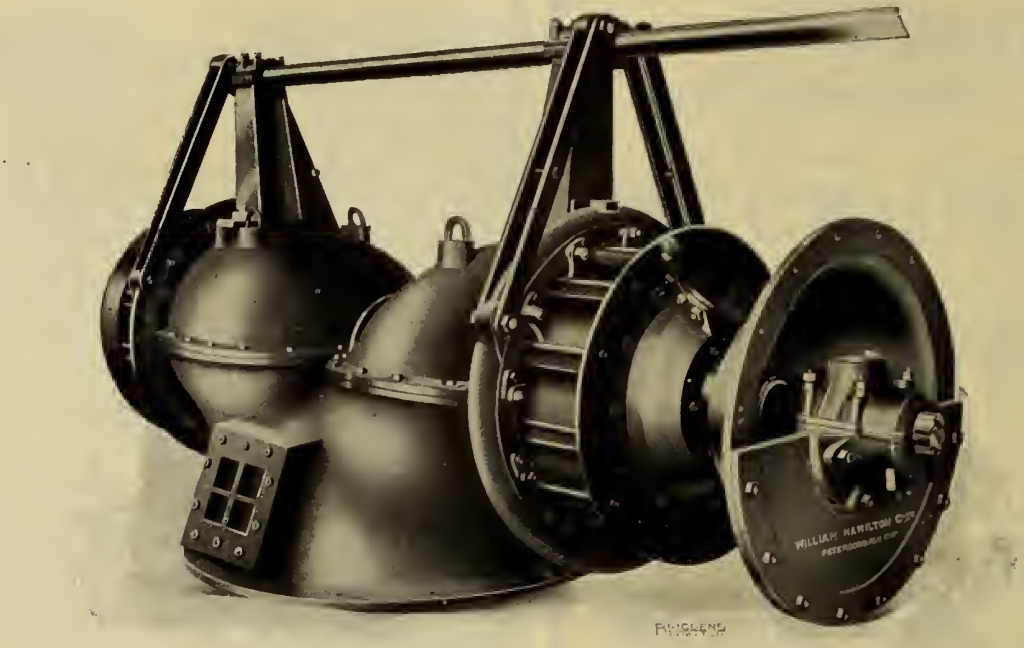
We have supplied poles for some of the most representative installations made during the past year.

We are at your service with suggestions and specifications and will give immediate attention to your inquiries.

All our poles are made of of the best grade
Cast Grey Iron throughout
which guarantees
INDEFINITE LIFE

ORNAMENTAL LIGHTING POLE CO.
POLES FOR ALL TYPES OF LIGHTING
· 114 LIBERTY ST. NEW YORK ·

All poles for Canadian shipment are made in the Province of Ontario.



Samson Water Wheels

Vertical or Horizontal Installations supplied. Our Samson Wheels in Holyoke tests have reached 89.99 per-cent efficiency, which guarantees their satisfactory operation under your conditions. Catalogues or preliminary plans and estimates will be gladly furnished upon request.

Headgate Hoists

We build a complete line of Headgate Hoists suitable for all conditions, and for either hand or power operation.

Send us particulars of your requirements and let us quote you.

William Hamilton Company, Ltd.

Peterborough - Ontario

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Press
one button
once!

The simplest and most efficient intercommunicating private telephone system. Durable in construction and ahead of the times in design.

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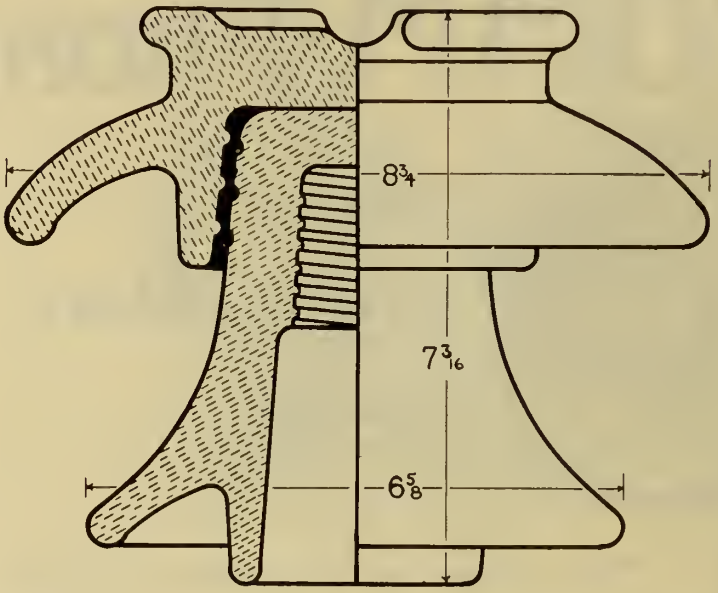
Code No. 905
6-Station
Desk Set
Other Sizes — Several Styles
12-22-32
Station Capacities

CANADIAN INSULATORS



Number	133
Line voltage	30,000
Test voltage	100,000
Rain test	65,000
Leakage distance	17¾-in.
Pin hole	1⅜-in.
Net weight	10½-lbs.
Packed weight	12-lbs.
No. per crate	6

The Canadian Porcelain Company, Limited

HAMILTON, - CANADA

Have You Our Bulletin No. 1?

You Need It ***Get Acquainted***

Type "A"

We have just equipped the finest sheet steel shop in Canada accomplishing the combination of **highest quality, lowest prices and best service.**

"Cansteel" flush and surface switch, cutout or panel boxes—any style, thickness or finish—(enamel or imitation wood finish.) Nothing too small or too large.

We also make sheet steel shop and fireproof interior equipment, lockers, steel garages, etc.

Canadian Steel Products Co.

227-229 Wellington Street, Montreal

"STOVE LOAD" PROFIT

The name HUGHES stands for the best in Electric Heating Devices

Mr. Central Station Manager:---

Do you realize that your Electrical Cooking Load is the most profitable one you can have?

Notice what has been demonstrated by a central station in a city where they have the **largest installation of electric ranges** in the United States.

In this station the diversity load factor is 30 to 1. They have a 3000 K. W. connected stove load and have never had more than 100 K. W. of this load on their "peak."

This means excellent profit to you in pushing **HUGHES RANGES.** We make fifteen different types of heavy duty ranges.

Write for our catalogue and price list.

Right now is the time to get busy!

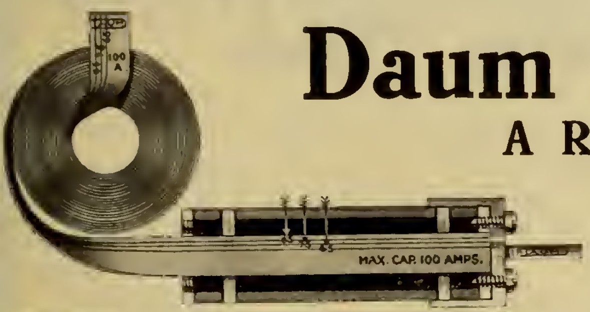
Hughes Electric Heating Co.

Canadian Factory, Winnipeg.

211-229 W. Schiller St., Chicago, Ill.

Daum Refillable Fuse

A REAL MONEY SAVER

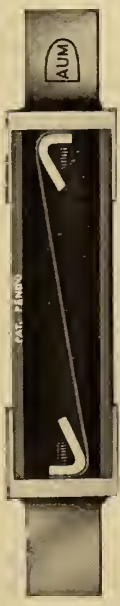


65 to 600A 250 or 600V

Safety First, Last and all the time.

The Roll that saves your Roll.

3-60A 250 or 600V



Made in all Standard Types and Sizes

A fuse which not only reduces your fuse bill to the cost of inexpensive refill elements, but one which is designed to give practically permanent service.

No threads to strip or burn on the fibre cartridges of our latest models—no rivets, screws or clamps to get loose. The fibre is left free to expand or contract without weakening the electrical connection.

Fuse elements will carry a 10 per cent. overload indefinitely and are guaranteed to blow at 25 per cent. or less, overload.

The Daum Fuse saves practically its cost each time it blows. It saves investment in a large stock of fuses—first cost is virtually the only cost. It saves time, labor and money in refilling and it lasts indefinitely.

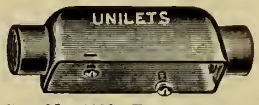
We will gladly send you a sample to test out yourself. When sending for it ask for our booklet, No. 17, Bulletin J 14.

A. F. DAUM CO., Pittsburgh, Pa.

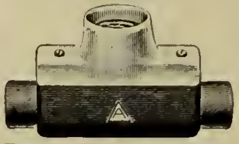
"UNILETS"

are drawn from steel and possess many merits which are an absolute necessity for up-to-date conduit work. For durability, neatness, space for making wire connections, "Unilets" meet all requirements. "UNILETS" are mechanically right. The conduit is steel, why not the fitting? Try them on your next job. A copy of our new catalogue should be before you. You cannot afford to be without it. Write us at once for your copy.

Cat. No. 9001—Rectangular Unilet.



Cat. No. 9002—Rectangular Unilet.



Type No. 2—Rectangular Unilet. Cat. No. 9002 with No. 7650 Receptacle.

Type No. 1 Octagon Unilet. Cat. No. 7501.

Type No. 4—Round Unilet with enclosed Snap Switch.

Cat. No. 7322—Shade Holder

Cat. No. 6906 Vapor-Proof Unilet.

Combination Plug Receptacle and Push Button Switch Unilet—Hubbell Plug Receptacle and Arrow E Push Button Switch Attached.

Type No. 1—4-inch Round Unilet with Two-phase Receptacle Attached.

Type No. 2 – Switch Unilet. Cat. No. 6501, with Push Button Switch Attached.

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APPLETON ELECTRIC COMPANY

Main Office and Factory **CHICAGO** 212-214 N. Jefferson Street

For Sale in Canada by

The Mainer Electric Co., Ltd., Winnipeg **Marshall-Wells Co., Ltd., Winnipeg** **Chapman & Walker Ltd., Toronto**

Electric Generating Plants

DIRECT RUNNING
AUTOMATIC
OR
STORAGE
BATTERY SETS

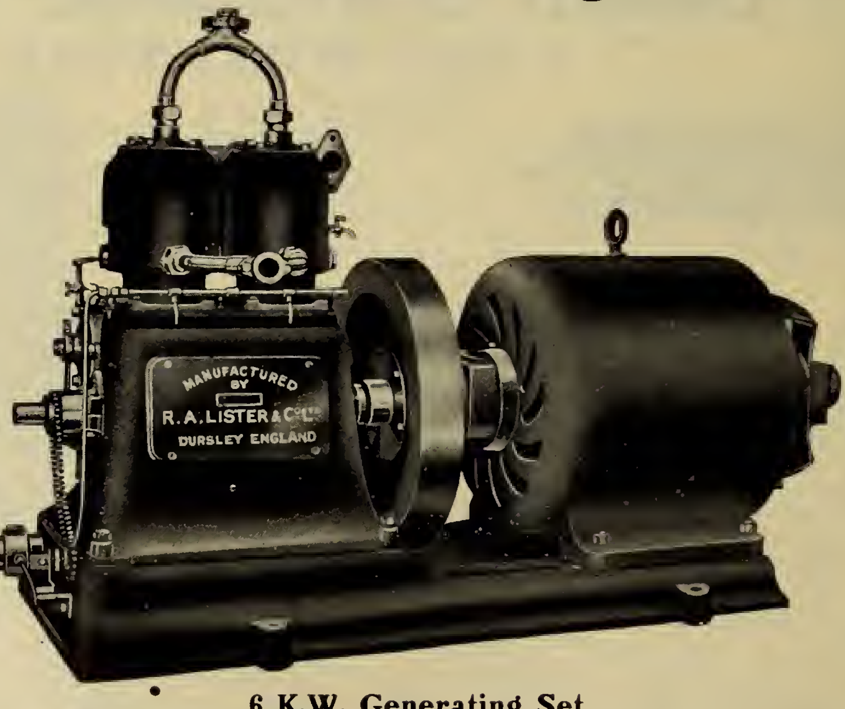
Description

Direct Coupled or Belt Driven.

One, Two or Four Cylinder Engines.

Stocked in 50-60, 110-115 and 220 volts.

.5, .75, 1.00, 1.6, 2.0, 2.6, 3.5, 4.0, 5.0, 6.0, 10.0 and 12.0 kilowatts capacities.



6 K.W. Generating Set

Hundreds in Use For

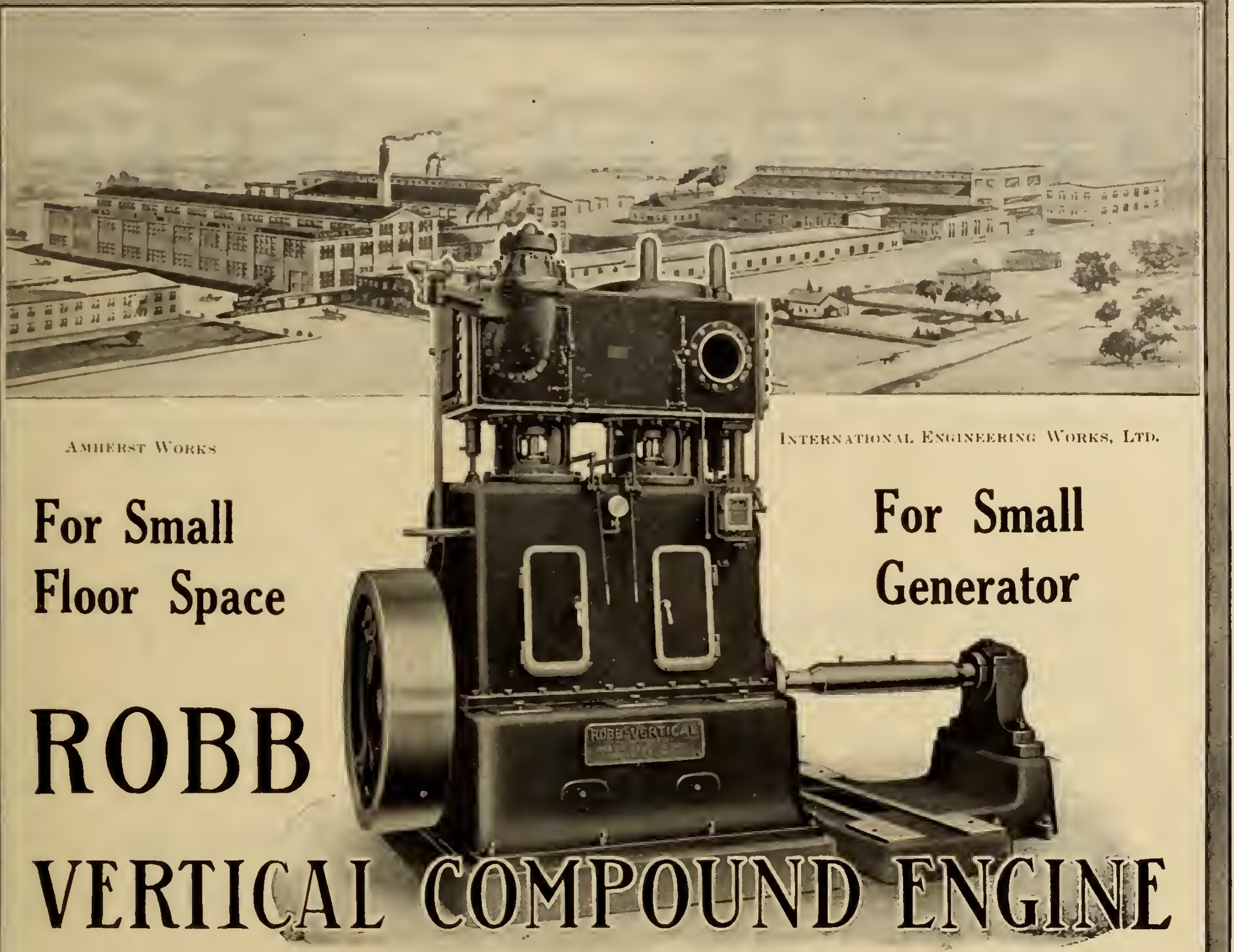
Small Towns.
Moving Pictures.
Street Lighting.
Mining Plants.
Contractors' Plants
Hotels.
Country Houses
Factories.
Etc., Etc.

Running on Gasoline, Natural Gas, Town gas and Kerosene.

Send for Catalogue "E" and Prices.

R. A. LISTER & COMPANY, LIMITED

Winnipeg **58-60 Stewart St., TORONTO** **St. John, N. B.**



AMHERST WORKS

INTERNATIONAL ENGINEERING WORKS, LTD.

For Small Floor Space

For Small Generator

ROBB

VERTICAL COMPOUND ENGINE

High Speeds of Rotation with pistons of large diameter give a powerful engine in small space. The direct-connected generator can be of small diameter because of the high speed so that the unit will be of relatively low cost and small dimensions for a given kilowatt output.

Quiet and satisfactory operation at piston speeds of only 500 to 800 feet per minute make these engines particularly adapted to electric light plants and electric railway service—installations requiring high-grade durable engines which will operate under a great range of load.

Long periods of operation without attention are made possible by the system of forced lubrication which supplies all bearings with an abundance of oil.

Complete enclosure of all moving parts prevents oil from flying about and protects the parts from accidental injury.

Low Steam Consumption is due to the very small clearances, high speed, automatic governing, and refinement in finish.

Ask for Bulletin No. 201.

INTERNATIONAL
ENGINEERING WORKS, LIMITED

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- Porcelain Insulators
- Crystal Fixtures
- Pearlite Glass
- Venetian Glass
- Carrara Glass
- Marble Glass
- Hand Decorated Glass

Bowls and Shades for illuminating purposes.

We carry a full line of fancy electric balls, globes, shades, crystal fixtures, prisms, etc.

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GEO. STOEVER

Canadian Representative

64 Wellington St. West. - TORONTO

Packard

A WORD ABOUT OUR SERVICE

¶ Packard Service is a National Service, instituted and maintained to give our patrons prompt and careful, expert attention.

¶ To insure immediate shipment of orders, large stocks are carried at—St. Catharines and Winnipeg; Eastern Elec. Co., St. John, N. B., General Supplies, Limited, Calgary, Alta; and Rudel-Belnap Machinery Co., Canadian Express Bldg., Montreal, P. Q., General Sales Office — 901-2 Traders Bank Bldg., Toronto, Ont.

¶ When ordering address nearest supply station.

THE PACKARD
ELECTRIC CO., LIMITED

ST. CATHARINES TORONTO WINNIPEG

¶ **Packard**—the wallmark of meter quality—when you see the name on a meter it reminds you of the quality of Canadian manufacture that has stood for fifteen years. To-day there are over 70,000 Packard Meters in use in Canada.

Packard

¶ Recent improvements have made the **Packard**, with no exception, the best meter anywhere. Re-inspections of the Government have thoroughly demonstrated that the "**Packard**" will retain its accuracy of calibration over years of service. Install "**Packard**" and guarantee your meter service.

THE PACK ELECTRIC CO.

ST. CATHARINES TORONTO

¶ The name Packard is worth paying for. You may pay a little more, but every time we make a sale our reputation is at stake and the name is always a guarantee of quality.

Packard

DISTRIBUTING TRANSFORMERS
for
POWER and LIGHT

Packard Transformers are designed to insure the highest efficiency in continuous service to the user. The superior quality of material and strong and rigid mechanical construction will effect a large saving in one year over ordinary transformers. It is the low cost of maintenance which makes the "Packard" so economical.

HE PACKARD
RIC CO., LIMITED
RINES TORONTO WINNIPEG

Packard

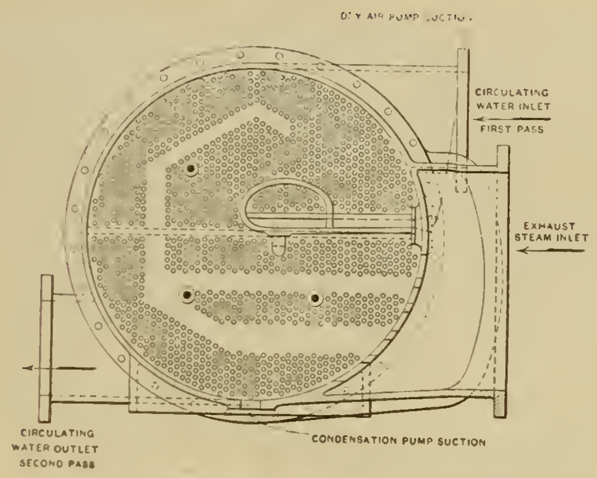
MAZDA LAMPS

are now being sold to the trade at greatly reduced prices. The dealer who takes advantage of the new schedule of prices in "Packard" Mazda Drawn-Wire Tungsten Lamps is certain of larger sales and greater profits. The opportunity of selling a high-grade lamp at an exceedingly low price is now yours.

¶ Get our prices. We are making special arrangements with dealers to supply their entire requirements.

THE PACKARD ELECTRIC CO., LIMITED

ST. CATHARINES TORONTO WINNIPEG



Alberger Spiro-flo Surface Condenser

The efficiency of steam turbine installations depends upon a high vacuum economically obtained.

ALBERGER

Surface, Centrifugal and Barometric Condensers

are designed for this service. The following is a partial list of recent Canadian installations. We will be glad to send you bulletins and the benefit of our long experience is at your command.

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United Shoe Machinery Company of Canada, Montreal, P.Q.
Northern Electric Company, Limited, Montreal, P.Q.
Prince Rupert Dry Dock, Prince Rupert, B.C. (two equipments).
Quebec Harbor Commissioners, Quebec, P.Q.
Montreal Light, Heat & Power Co., Montreal, P.Q. (two equipments).
Riordon Pulp & Paper Company, Hawkesbury, Ont.

The natural result of checking up the water rates of your turbines by means of a

HAMMOND WATER METER

is increased efficiency.

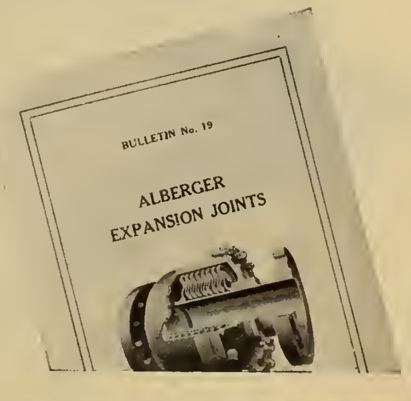
High efficiency in feeding boilers is obtained by using

ALBERGER
Centrifugal Boiler Feed Pumps

driven by Alberger-Curtis Steam Turbines, which have low steam consumption at moderate pump speeds.

ALBERGER STEEL EXPANSION JOINTS

are designed to withstand steam or water pressures up to 200 pounds per sq. inch. The remedy for many expansion joint troubles will be found in the new Alberger Bulletin 19, a copy of which will be mailed upon request.



BULLETIN No. 19

ALBERGER
EXPANSION JOINTS

Alberger Pump & Condenser Company
140 Cedar Street
NEW YORK

Meter Testing Equipments
Portable Loads Accessories
The States Co.,
HARTFORD, CONN.
15 New Park Ave.

RETAIL BILL AND CHANGE MACHINE
With Automatic Tally

THIS is one of thirty models of the Underwood.

There is an Underwood for every requirement of writing, recording, accounting, and statistical work.

Special-purpose Underwoods effect remarkable economies in the office—in many cases incredible until we submit the proof.

There is an Underwood for your special needs.

United Typewriter Co.
Limited

In All Canadian Cities

ELECTRICAL SHEETS

Apollo Special

High Grade Electrical Sheets of Silicon Alloy Steel, patented. Highest electrical efficiency; for Transformers, Dynamos and Motors. Minimum heating, maximum capacity, non aging.

U. S. Electrical

High Grade Electrical Sheets for Transformers and high class Electrical machines, especially prepared to show low magnetic losses with minimum aging tendencies.

American Armature

Good grade, especially suitable for intermediate operating and for large slow speed machines.

Manufactured by

The American Sheet & Tin Plate Company
Pittsburgh, Pa.

B. & S. H. THOMPSON & CO. LIMITED
CANADIAN SALES AGENTS:

UNITED STATES STEEL PRODUCTS COMPANY

Transportation Building
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POLSON IRON WORKS LIMITED

Toronto, Ont.

STEEL SHIPBUILDERS, ENGINEERS and BOILERMAKERS

Engines and Boilers for Stationary and Marine Work—all sizes and kinds

BOILERS—(For Stationary Work) Horizontal Return Tubular
Heine Water Tube, from 100 to 1000 H. P. Units

ENGINES—(For Stationary Work) Vertical High Speed
The Brown Automatic

TANK WORK—Smoke Flues Stand Pipes Water Towers

REPAIR WORK—Prompt Attention Given to Repair Work

WORKS and OFFICE - ESPLANADE EAST

Hold On

That is what you want your Rail Bonds to do. There are several kinds of bonds that will do it. There is *one* kind that not only will hold on, but absolutely will not corrode at the terminals.

Electric Welded bond terminals are guaranteed.

The Electric Railway Improvement Co.

Cleveland, Ohio

Representatives Wanted

Here is a splendid opportunity to handle these tried and tested instruments in your section. For 20 years we've specialized on this class of work and today "Connecticut" instruments are justly famous for their high quality and reasonable prices.

CONNECTICUT

Electric Reset Annunciators

and

Interior Telephones

"Connecticut" Annunciators and "Connecticut" Interior Telephones appeal to the user because they are simple in construction, effective in action, look good, wear well and give lasting service.

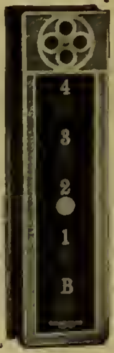
Made in a wide variety of styles and sizes—each style suited to its particular requirement. You're selling satisfaction — making lasting customers — when you sell "Connecticut" goods.

Write for Catalog 22C and Full Details

Ask us for particulars of our proposition for representatives. Look over our Catalog and note the completeness, reasonable prices and high quality of the "Connecticut" Line.

Connecticut Telephone & Electric Company, Inc.

Meriden, Conn., U. S. A.



We Purchase Outright

entire issues of bonds on steam and electric railroad, gas-electric and hydro-electric properties.

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Established 1882
Incorporated 1911

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Electrical Decorations For Rent

We make a specialty of High Class Decorations for Street Fairs, Carnivals, Celebrations, Centennials, Old Home Weeks, Street Conventions, Conclaves, Parks, Buildings, Auto Shows, Balls, Fairs, Dances, Banquets, Industrial Expositions, Food Shows, Christmas and New Years, etc.

Our decorations are elaborate, appropriate and refined. We carry a complete line of Electrical Set Pieces, Signs, Streamers of Lights and Bunting for all Lodges, Orders and all occasions. Get our prices and designs.

Electrical Decorative and Equipment Company

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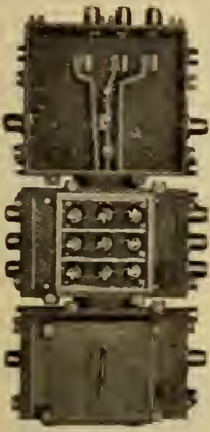
Long distant phone Main 3634



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OUR NEW CATALOG NO. 8 MAY SHOW YOU JUST WHAT YOU WANT. WE HAVE ARRANGED IT TO SAVE YOUR TIME AND HAVE DESIGNED DEVICES TO SAVE YOUR MONEY. SAFETY AND RAPID RESTORATION OF SERVICE ARE ESSENTIAL TO ANY COMPANY.

G&W ELECTRIC SPECIALTIES

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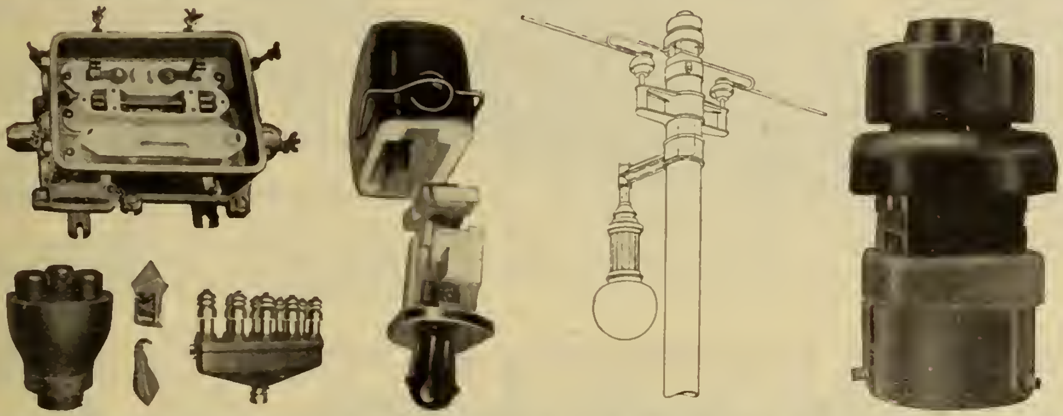
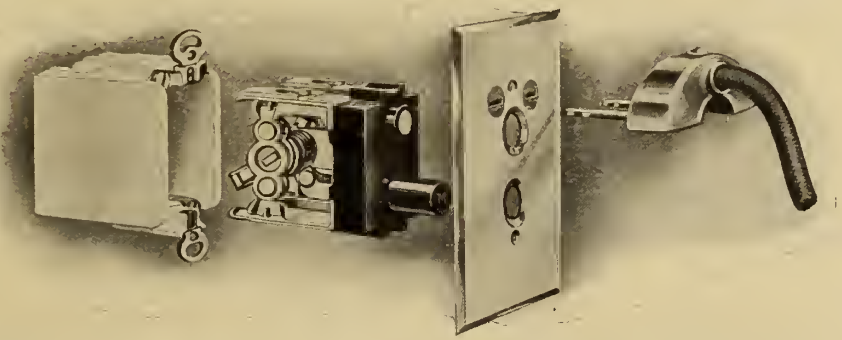


TRADE **METROPOLITAN** MARK
ELECTRIC MFG CO.

Panelboards, Switchboards, Knife Switches, Detachable Mechanism Flush Switches and Receptacles,

One Contact Box, One Face Plate with Renewable, Interchangeable Mechanism and Receptacle Plugs



Metropolitan Detachable Mechanism Combined Switch and Receptacle.

Send us your specifications, our price is right, and delivery the best.

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The Ideal Power Plant

PLANTS NOW SUPPLIED OR ON ORDER

Plants Working* *Town of Rapid City, Man.
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For Town Electric Lighting, WaterWorks or SewageDisposa

For Economy, Reliability, Ease of Cleaning Without Stopping the Plant, Clean and Cool Gas, Simplicity, and for Generating Electricity there is no Plant like the—

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Suction Gas Engine and Producer

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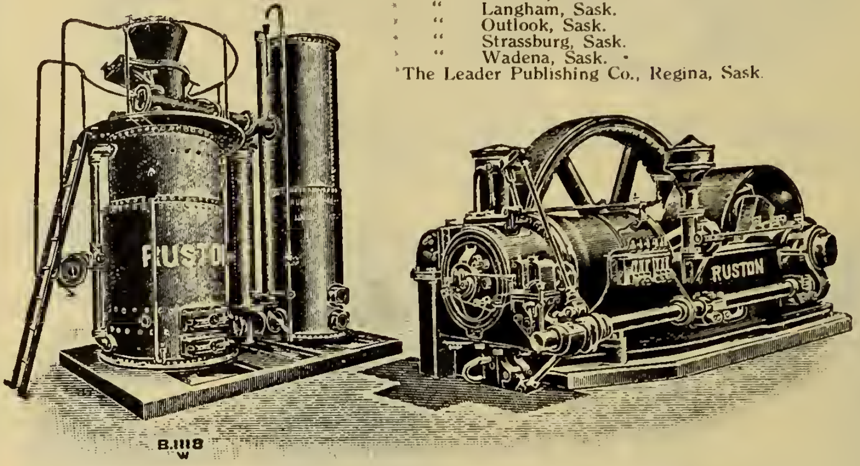
Patent Producers for using all kinds of Wood Refuse—as Wood Blocks, Bark Chippings, Sawdust, Etc.



Ruston Suction Gas Producer for Anthracite and Ruston Gas Engine.

British-Canadian Engineering & Supply Co., Ltd.
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Manufacturers of

HIGH CLASS ELECTRIC SHADES AND DISHES

FOR SEMI-INDIRECT LIGHTING, ETC., ETC.

SOLE MAKERS OF THE "ONYXIT" GLASS.

"Onyxit" Glass gives a beautiful soft, effective white light, with an entire absence of glare.

"Onyxit" Glass, through its special composition has great resisting power, which makes it suitable for lamps of high wattage.

"Onyxit" glass is also made in several nice soft colors for decorative purposes.

The use of **"Onyxit"** Dishes with hand painted decorations, or of white dishes with relief design, gives a rich and artistic appearance to the fittings.

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Duncan Quality

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Guaranteed by this Trade Mark

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Sign Receptacles for Electrical Sign Makers

No. 988

No. 988 is a two piece sign receptacle, insulating point of contact from lamp shells. A thoroughly reliable receptacle of "Duncan Quality."

No. 29

No. 29 is a **self holding** receptacle, strongly made and sheet metal holder. It requires only a plain **round** hole in sign and thus it is more easily and quickly adjusted. Another point is the fact that the making of plain **round** holes is easier on your punches and makes them last longer than if the hole were notched.

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The Duncan Electrical Co., Limited

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Makers of "Duncan Quality" Electrical Supplies

Pole Line Hardware

That withstands the test of time and weather

Transmission
Wires,
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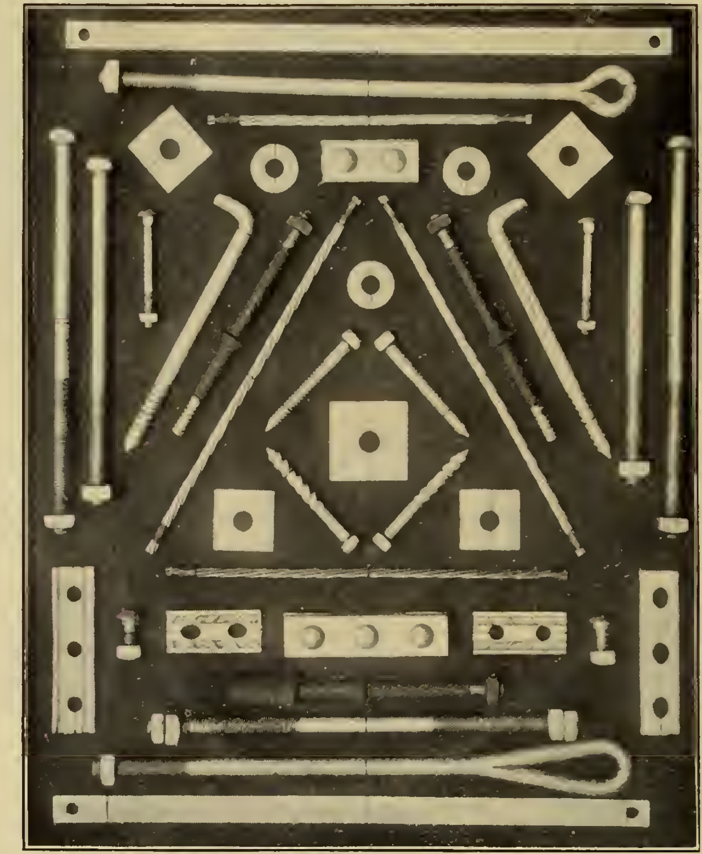

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Lowest Prices
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For Electrical Construction Work,
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Send us your specifications to quote on.

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Hamilton Toronto Montreal Winnipeg
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A NEW LAMP—A NEW PROCESS

THE ELMAIN EFESCA WIRE LAMP

The Filament is ANNEALED. If you have handled wire, you will know that a hard wire breaks easy, that if you anneal it, it will not break. The Annealing is the secret of this lamp's unparalleled lasting quality.

But you will find many lamps that *last* because they have been made tough at the expense of efficiency.

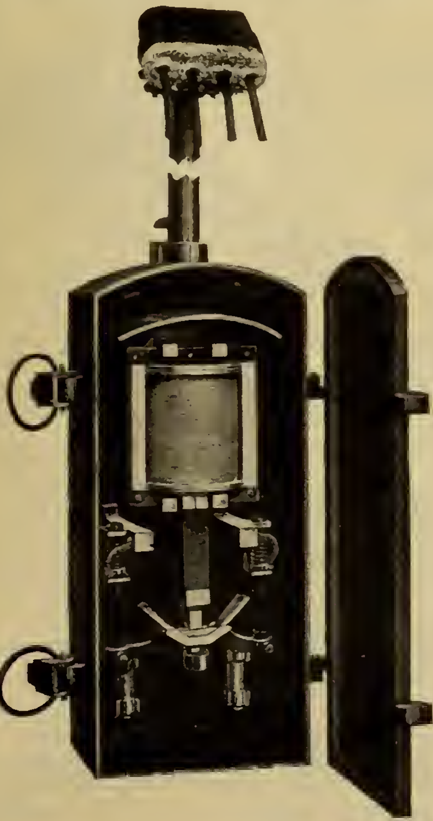
NOTE THIS—**The efficiency of this lamp is 1.1 Watts per candle.**
It is remarkably tough when you first get it.
It is tougher after 200 or 300 hours' run than when first put in service.
And it's LOW IN PRICE.

Where else can you get this combination?

Agents wanted everywhere. Write to-day, state your probable requirements during the ensuing year and get the exclusive rights for your town before the other fellow does. **You can beat him in Price and Quality.**

SPECIAL PRICES TO CENTRAL STATIONS

Solenoid Switches for Remote Control of Street Lights



This cut shows our Type 17 H.E.P. Solenoid switch which was adopted by the Hydro-Electric Commission of the Province of Ontario and used by them in a large number of Ontario towns.

Orders are received from all the Provinces.

This switch is no experiment. The fact that it has been adopted by the Hydro-Electric is proof of its success.

No springs, swivels or other complicated mechanisms to give trouble. They close magnetically and are opened by gravity assisted by the tension of the laminated copper contact. All arcing is taken up on the carbons.

Increase the efficiency of your system and decrease the cost of installation by using our Type 17 H.E.P. Solenoid Switches, which are suitable for any frequency on multiple circuit or D.C. Series circuit.

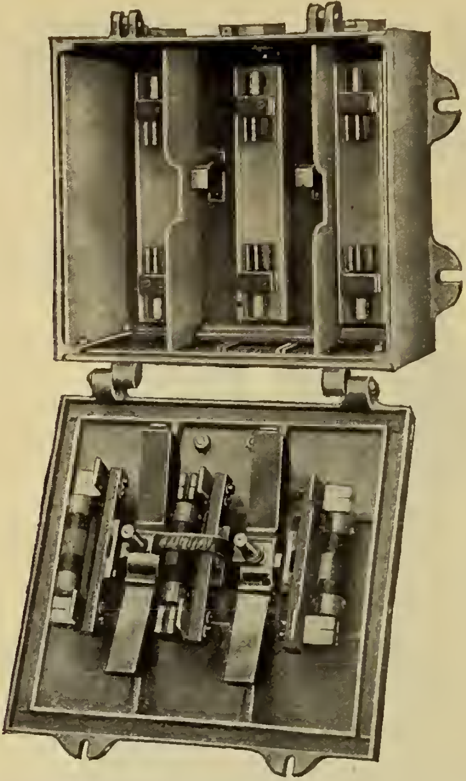
Essential for Modern Street Lighting Methods. Let us send fuller particulars.

How About Your Electric Repairs ?

We have expert repair men available at a moment's notice to make repairs at your plant or at our works. They have repaired some of the largest machines in the country.

If you you want complete, quick service, wire us.

The Electrical Maintenance and Repairs Co., Limited
162 West Adelaide St., Toronto
Phones—Adelaide 902-903 **Nights—Beach 1723-1930**
FOR ALL YOUR ELECTRICAL REQUIREMENTS



T. P. "Masta" Patent Fused-Switch, with National Standard Code Fuses.

The FIRE HAZARD

Do not think only of loss by fire, but guard your employees against electrical accidents.

BERRY'S PATENT

ironclad fuse-switch gear is used in every civilized part of the world, and is absolutely fool-proof.

Write for particulars to the sole agents in your territory:—

FEDERAL ENGINEERING Co., Limited
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CANADIAN-BRITISH ENGINEERING Co., Limited
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GENERAL SUPPLIES, Limited
122 Eleventh Avenue West, CALGARY

Berry, Skinner & Company, 78 Upper Thames Street, London, E. C., England

D. P. "Masta" Fused-Switch Weathertight Type.

The Quality of our Douglas Fir and Long Leaf Yellow Pine Cross-arms fully attested.

The Largest manufacturers in the East.

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INSULATOR TOP PINS, BRACKETS

Oak,
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Insulator Top Pins,
Brackets and Pole Steps

Pins for High Voltage Transmission a Specialty

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"From Coal to Customer"

requires many connections in your power and sub-stations. The current surge that may burn out soldered connections will be safely carried if those connections are made secure and reliable with

Dossert Connectors and Terminals

They have

100% PLUS of the Cables' Carrying Capacity

Dossert Connectors form mechanical connections without soldering. They save considerable time and labor in the erection of apparatus and afford easy facilities for disconnecting circuits in case of trouble or when temporary connections are required. Their field of usefulness is a large one in power and sub-station wiring.

Ask for Our Tenth Year Catalogue

Dossert & Company

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242 West 41st St. - - - New York

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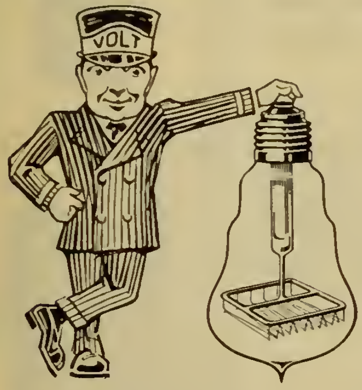

A TUNGSTEN LAMP THAT'S *DIFFERENT*

More Light **LELIOS** **More Sales**

Specially constructed to throw the light DOWNWARD where it is most useful

Note the construction. The drawn wire Tungsten filament is suspended in a horizontal position with no obstructions to cast shadows. The efficiency is doubled by the use of shades and particularly with Moonstone Glass shades No. 4051 and No. 4053
For office, factory and store lighting the "Lelios" is unexcelled.
Large business awaits the dealer who handles the "Lelios" lamp.

Special prices to the dealers who write to-day.

UNBREAKABLE TUNGSTEN LAMPS

The strongest made. You can put one on a drop cord and strike it as you would throw a baseball — it won't break. We will sell both from stock and import.

A COMPLETE LINE OF DEALERS SUPPLIES

We also carry a complete line of electrical supplies with special, attractive prices on fuses and fuse devices. Get our price on everything electrical.

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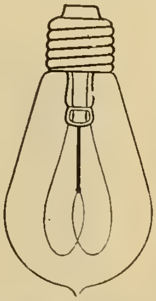
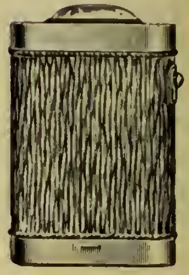




AN ANNOUNCEMENT

WE take pleasure in announcing the opening of our office, stock and show rooms at the below mentioned address.

Having acquired the sole rights for manufacturing and selling the well known "FRANCO" products of flashlights, lamps, batteries and other electrical novelties, in Canada, we will be in position to offer the trade advantageous prices and prompt deliveries.

Write us for catalogue.

The trade mark FRANCO stands for guaranteed quality. Insist on "FRANCO" flashlights, lamps and batteries.

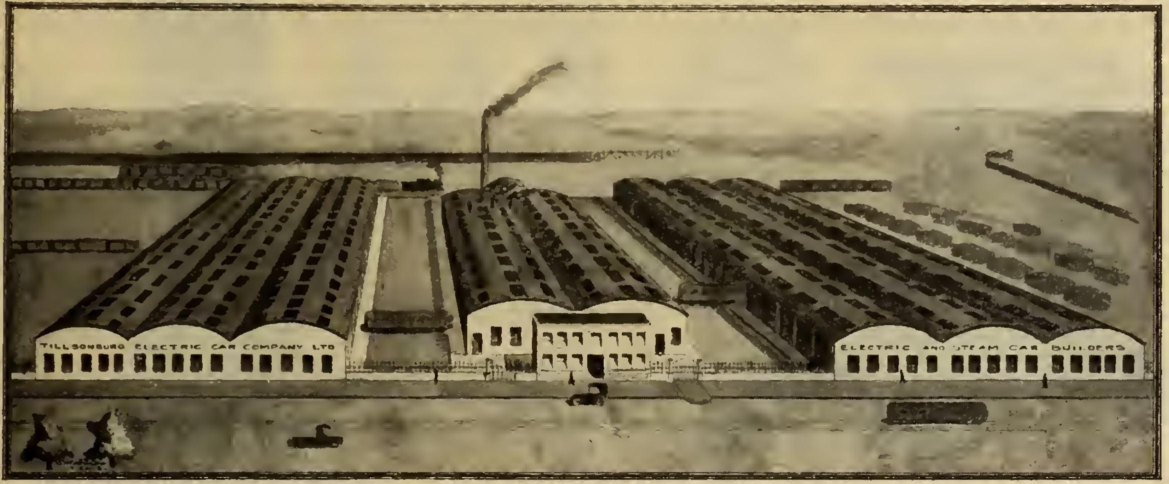
INTERSTATE ELECTRIC NOVELTY CO., LIMITED
of Canada
220 King Street West, TORONTO

EXPERIENCE—

—MORE THAN SIXTEEN YEARS AGO WE WERE MANUFACTURING ALUMINIUM FOR ELECTRICAL WORK—AND WE HAVE BEEN DOING IT EVER SINCE. SELECTED MATERIAL, EXPERT SUPERVISION, PRECISION TESTING AND — EXPERIENCE ARE PART OF OUR SERVICE TO YOU.

LET US MAIL YOU OUR BULLETINS

THE BRITISH ALUMINIUM CO., LIMITED (of London, England) **60 W. FRONT ST., TORONTO**


TILLSONBURG ELECTRIC CAR COMPANY LTD
ELECTRIC AND STEAM CAR BUILDERS

The Tillsonburg Electric Car Co., Limited

Manufacturers of

ELECTRIC CARS, SWEEPERS AND SPRINKLERS

Orders for electric cars are now coming in fast and building operations are in full swing.

Will you need new equipment for summer delivery? If so get in touch with us as soon as possible in order that you may rely on getting your cars when needed.

Office and Works, - - Tillsonburg, Ontario

Quality CANADIAN BEAUTY ELECTRIC HEATING APPLIANCES *Service*

TRADE MARK

Electricians recognize "Canadian Beauty" Irons and other Heating Appliances as being the height of perfection. Imported appliances do not compare with these goods which are made at home for the Canadian market.

"Canadian Beauty"
ELECTRIC SAD IRON

This beautiful Iron is built for service—service that will satisfy; that is the reason why it is favored for household and laundry use. It is heated by an element that evenly distributes the heat over the whole ironing surface, thus getting the greatest efficiency from a minimum of current.

GUARANTEE: Should the heating element prove defective at any time, a new one will be given by your dealer or by us. It is guaranteed for all time.

Weight 6½ lbs. 110 Volts. 500 Watts.

'Canadian Beauty"
ELECTRIC TOASTER

This Toaster is very strongly made, beautifully finished in polished nickel, and is insulated so that no heat reaches the base, thus overcoming any possibility of damaging the surface of any table on which it may rest.

This Toaster will toast two large slices of bread very quickly and enough toast for a family of six can be made in ten or twelve minutes. The top of the Toaster is designed for holding toast and keeping it hot, or a coffee pot can be placed thereon, as there is sufficient heat reaches it to keep the coffee at boiling point.

GUARANTEE: The Toaster element is guaranteed for two years. With ordinary care, however, it will last a life-time. 110 volts. 550 Watts.

Manufactured by

Renfrew Electric Manufacturing Company, Limited

Renfrew Ontario Canada

Tallman Fixtures

They're different

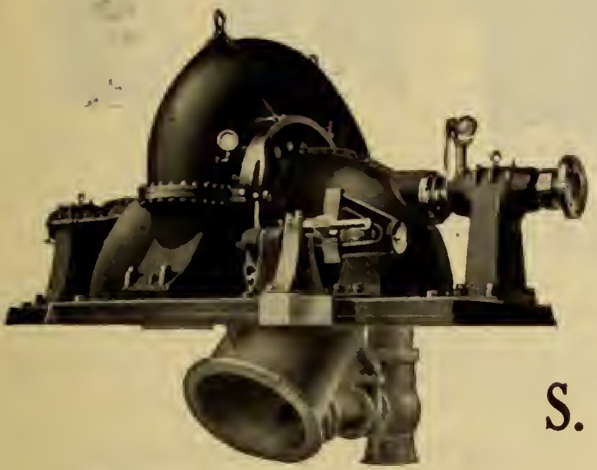
Bronze Standards supplied to First Methodist Church, Hamilton

MANUFACTURED BY

Tallman Brass & Metal Co.
HAMILTON, ONT.

90% Efficiency

From Smith Hydraulic Turbines



5250 Horse Power—275 Feet Head.

Recent tests at Holyoke, Mass, of Smith Turbines have again proven their superiority over any turbine now manufactured.

These tests showing efficiencies from **89% to over 90%.**

We design and build turbines for heads from 5 feet to 650 feet.

Send for Bulletin N.

S. Morgan Smith Co., York, Pa.

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ELECTRICAL MACHINERY

Motors, Dynamos, Generators, Electrical Pumps and Supplies, Motor Repairs.

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Representing
THE LINDSLEY BROTHERS COMPANY, SPOKANE
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MAC ELECTRIC COMPANY

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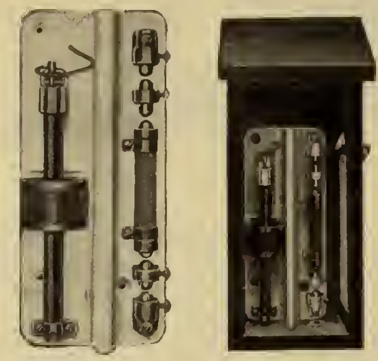
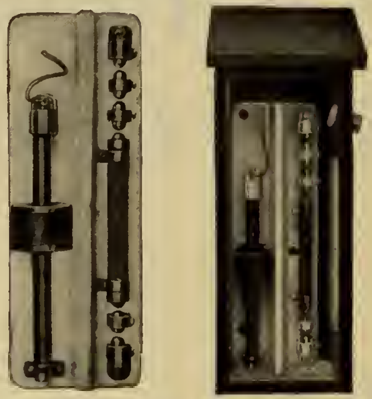
W. McINENLY, General Manager

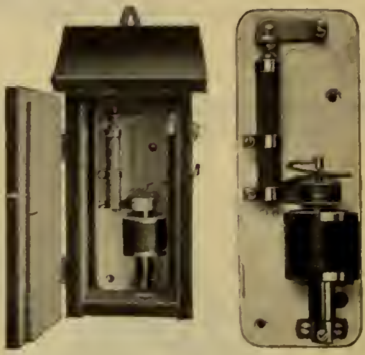
You Must Use These Lightning Arresters



Arresters for A. C. Service 1200 to 2500 volts.



Arresters for A. C. Service 2500 to 3500 volts.



Arresters or D. C. Servic 350 to 750 volt

To Get Complete Protection

Only Garton-Daniels Lightning Arresters can offer you "complete" protection. Their small air gap distance, low series resistance and positive mechanical circuit breaker insure efficient protection, eliminate low voltages, winking lights, etc., and make grounds and short-circuits through the arrester next to impossible.

Don't forget that one flash can cripple your entire plant—cost you a lot of money—loss of power—kicks from the public.

Your apparatus is not **protected** without Garton-Daniels. Order yours **now** before the lightning comes.

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The
Canadian Turbine Water Wheel

A normal speed Turbine of Normal Capacity. Not overgated or over-rated. Steady, Sturdy Power from Quarter to Full Gate.

Efficiency, Durability and Genuine Satisfaction assured.

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Established 1867

Transmission Brackets

for

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Telephone
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Acme Brackets

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Strong
Light
Easy to apply
Hot Galvanized

WE MAKE A BRACKET FOR EVERY PURPOSE—OUR CATALOGUE WILL GIVE YOU MORE DETAILED INFORMATION.

Acme Stamping & Tool Works
Limited
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You can go wrong

EVERY electric transmission engineer, every electric railway engineer and every power and central-station man knows the value of using only high-grade wires and cables for the distribution of electric power.

How many instances can you remember just off-hand where defective material in transmission lines has caused enormous losses to power companies, to say nothing of the losses to their many patrons? Quite a number isn't it? And how many more could you recall if you took the trouble to consult records.

And why? All on account of faulty wires or cables.

Now if you are contemplating the construction of a new line, or putting in new divisions don't forget that there is one brand of wires and cables that can always be depended on—"Canada."

CANADA WIRE & CABLE CO., LIMITED
CANADA
TORONTO CANADA

Canada Wire & Cable Co.
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Toronto 1170 Dundas Street Ontario

Sales Offices:

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Macdonald, Marpole Co., Ltd., 427 Seymour St., Vancouver, B. C.

SUCH discriminating care is used in the selection of raw materials from which CANADA wires and cables are made, and such extreme vigilance exercised during the course of manufacture that we are able to say that whenever you buy this well-known brand **you can't go wrong.**

Get our quotations on—

- Transmission Cables Copper and Aluminum.
- Weather Proof Copper and Aluminum Line Wire.
- Rubber Covered Wires and Cables.
- Railway and Power Feeder Cables in Copper and Aluminum.
- Copper Trolley Wire.
- Copper Clad Wire Bare and Weatherproof.
- Telephone and Telegraph Wire Bare and Insulated.
- Galvanized Steel Strand Guy Wire.

Prompt shipments made from stocks carried at Toronto, Montreal, Winnipeg and Vancouver.

You can't go wrong

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CANADA WIRE & CABLE CO., LIMITED
CANADA
TORONTO CANADA

Artificial Daylight at Last

Interior View of Lord & Taylor's New Store, Fifth Avenue, New York City—Showing how ALBEDOGLAS Bowls are used to produce what is approximately daylight.

Investigate the advantages of

ALBEDOGLAS

REGISTERED

For Store Lighting

Produces Approximate Daylight Color Values
Ideal for Matching Colors and for Displaying
Colored Merchandise

GLEASON-TIEBOUT GLASS COMPANY

Show Rooms at

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San Francisco, Cal.

Main Office: Brooklyn, N. Y.

Their Perfect Light Control Standardizes Eye Comfort Fixtures for Nitrogen Lamps

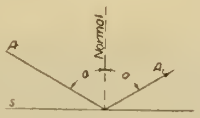
Eyes must be protected from the blinding brilliancy of the "Nitrogen lamp."

A most effective way of doing this is to conceal the lamp, and, by means of powerful X-Ray Eye Comfort reflectors direct the light against the ceiling at the proper angle, and evenly diffuse it throughout the room.

A Word About Light Control

Without perfect control of the light rays, searchlights, auto, and locomotive headlights, etc., would be impossible.

Some of these accomplish light control by means of a lens, others use correctly designed mirror reflectors. You never see anything but a mirror reflecting surface used in any of these appliances wherein control of light is so essential,—never porcelain, never white painted steel, never plaster or wood. The reason is that the mirror is the only surface which reflects the light rays thrown against it at exactly the same angle at which they strike the surface. (see figure 1). This quality is known as regular reflection.



Substances such as porcelain, white or aluminum paint, wood, plaster, etc., are diffusely reflecting surfaces. Instead of reflecting rays at the same angle, the light rays are "sprayed" back, so to speak, the light being reflected at all angles. This diffusely reflected light does not travel in any single fixed direction and it cannot therefore be controlled.

All X-RAY Eye Comfort Reflectors are mirror Reflectors designed in strict accord with this first law of light.

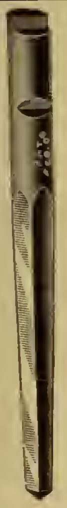
Write for information on nitrogen lamp fixtures.

National X-Ray Reflector Company

"Illumination from Concealed Sources"

Chicago
225 W. Jackson Blvd.

New York
6 East 39th Street



SEE
THAT
SQUARE
HOLE

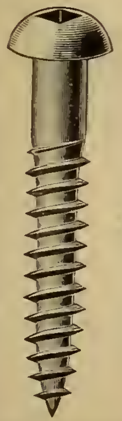
PAT. FEB. 2, 1909

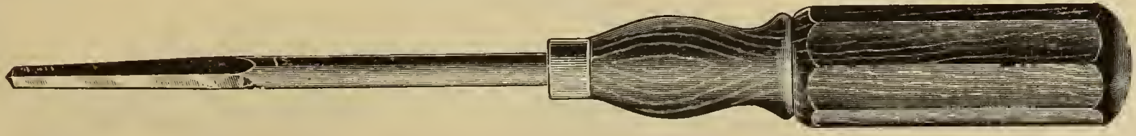
ROBERTSON SOCKET HEAD
WOOD SCREWS

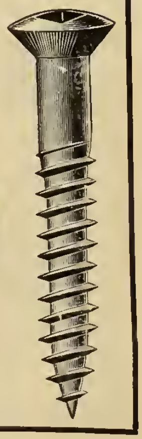
This new socket screw can effect a wonderful saving of time and material especially in electrical wire and fixture erection, etc.

They are used by simply placing the screw on the driver and then you may reach out at arm's length and drive it in with one hand. For overhead work or work between joists or under flooring it is invaluable.

Samples and Prices on Request







The P. L. Robertson Manufacturing Co., Ltd.
Milton — Ontario

Swedish Electrical Machinery

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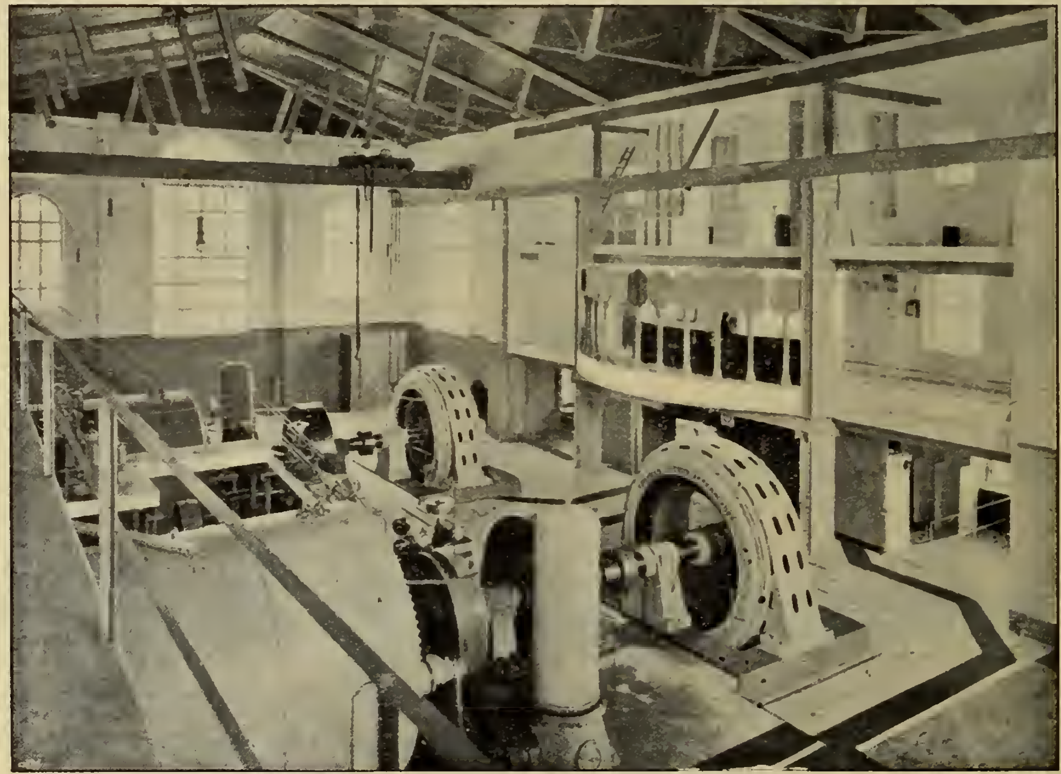

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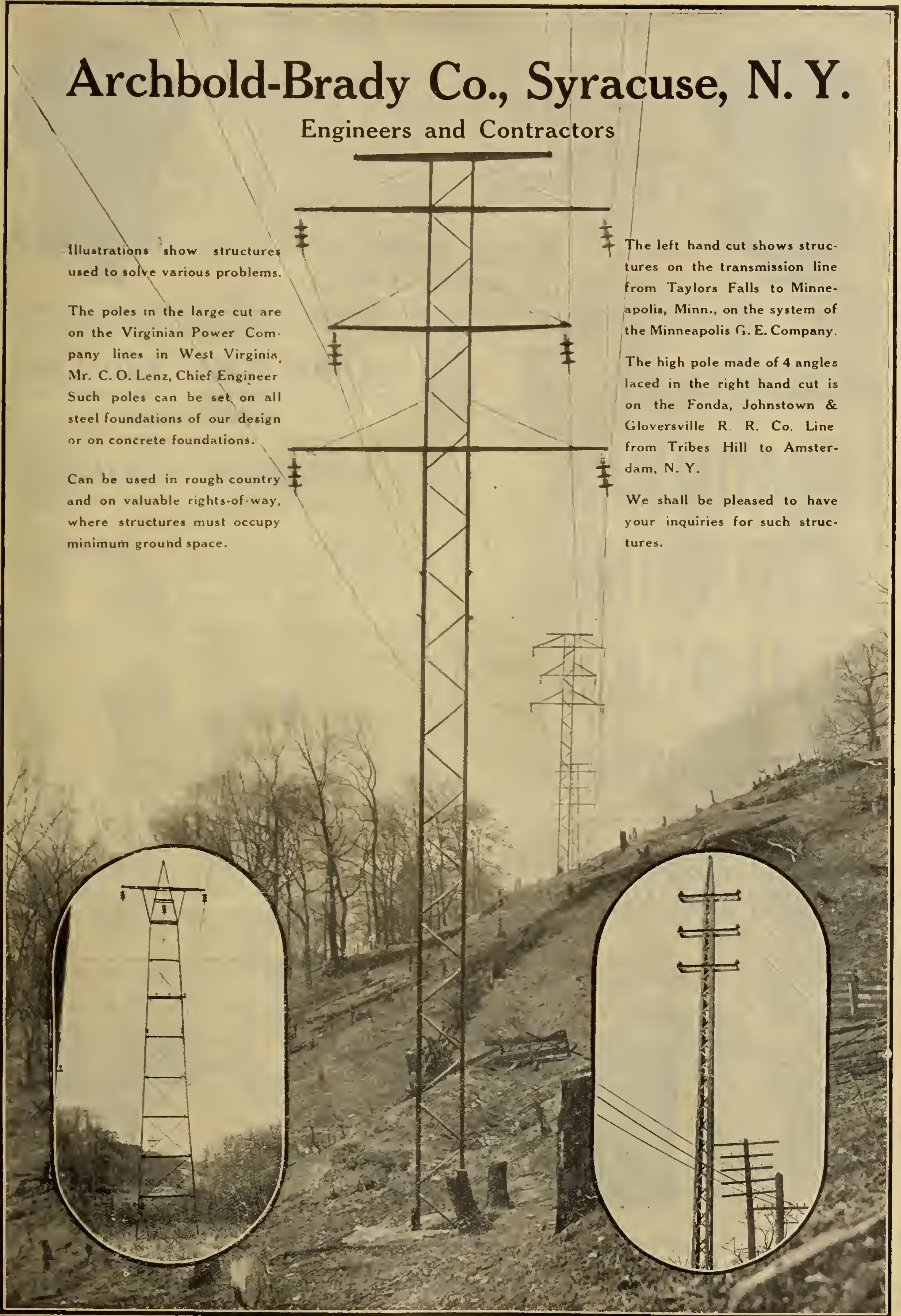
Engineers and Contractors



Illustrations show structures used to solve various problems.

The poles in the large cut are on the Virginian Power Company lines in West Virginia, Mr. C. O. Lenz, Chief Engineer. Such poles can be set on all steel foundations of our design or on concrete foundations.

Can be used in rough country and on valuable rights-of-way, where structures must occupy minimum ground space.

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Greatest device convenience comes from 5815 interchangeableness. Preach this feature and receive the profits.

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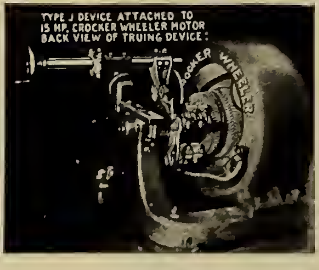
No portable slide-rest with the danger of the tool digging into the commutator and numerous other chances of damage to the commutator or armature which are all overcome with this machine.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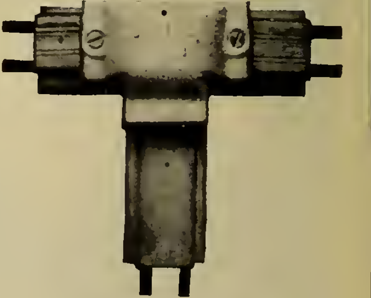
It is not necessary to have the ends of the capping straight as the cover of the Tapon overlaps the capping, thereby covering any bad ends of capping.



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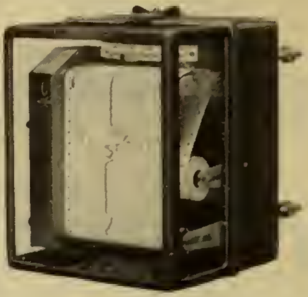

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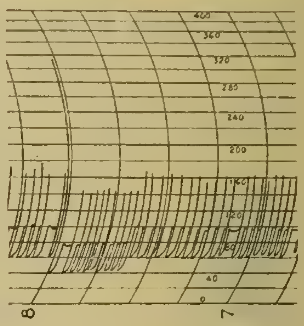

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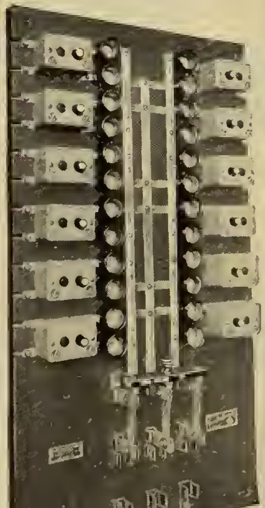

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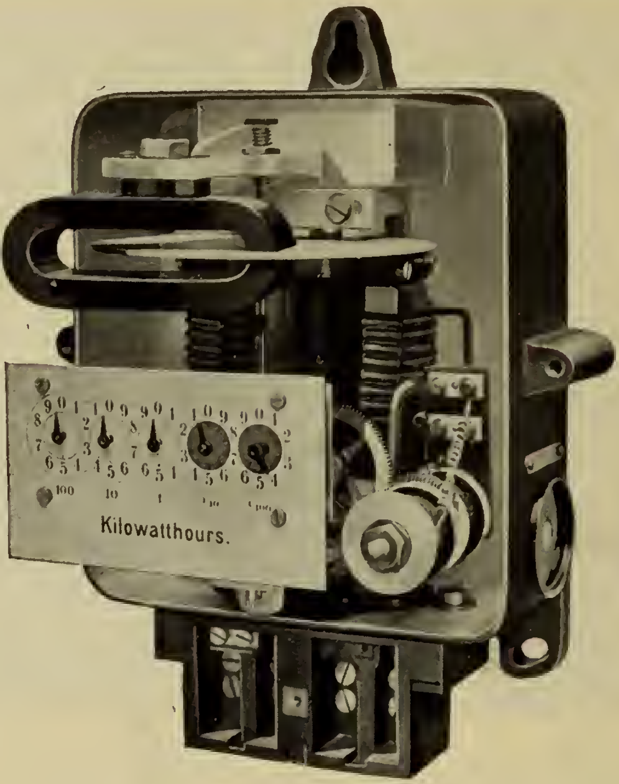

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Extract from Accuracy Test Report of New York Testing Laboratories

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1711190	.08 amp.	1.0 –	1.2 +	0.8 +	0.5 +	0.2 +	0.5 –	2.1 –
1770309	.065 amp.	2.9 +	0.9 +	1.9 +	1.2 +	0.8 +	0.1 –	0.2 +

It will be noted that our Type W3 meter has an accuracy within 2% from 1/20th of full load to 1½ times full load.

Immediate delivery of 60 and 25 cycle meters from stock in Montreal and Toronto.

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Generation, Transmission and Application of Electricity

Published Semi-Monthly By
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The "Electrical News" will be mailed to subscribers in Canada and Great Britain, post free, for $2.00 per annum. United States and foreign, $2.50. Remit by currency, registered letter, or postal order payable to Hugh C. MacLean, Limited.

Subscribers are requested to promptly notify the publishers of failure or delay in delivery of paper.

Vol. 23 Toronto, June 15, 1914 No. 12

Long Distance Transmission

The probable future developments in long distance transmission promise more for industrial Canada than any other influence that seems to be at work at the present moment. The potentialities of our undeveloped water powers, though placed at many millions of horse-power, are practically unknown and therefore underestimated. The estimates of the area and depth of the coal fields of western and northern Canada are little more than a guess though they indicate a practically inexhaustible power supply. Our power possibilities seem almost infinite. We have to admit the fact, however, that both our coal and water power supplies are not distributed as evenly over the Dominion as in our present state of development we could have wished.

An abundance of energy is the ultimate necessity of industrial life and it follows that our activities must either centre around these localities where power is available or power must be distributed. Up to the present the former alternative has ruled, but this must result ultimately in congestion and inconvenience and a discrimination against those sections of the country which are not fortunate enough to contain in themselves the necessary power supplies. In the final analysis, therefore, the general industrial development of our Dominion depends to a very large extent on our ability to distribute power evenly to all sections.

One has only to consider the history of the developments in telephones, telegraphs and railways to foresee the ultimate goal of long distance transmission. Telephone systems formerly consisted of a large number of small isolated installations. Later, with the development of equipment operative over longer distances, these were joined together, until finally we now have a complete net-work stretching from one side of the continent to the other. Telegraphs and steam railways have developed along similar lines and electric railways in many parts of the United States if not in Canada are showing the same inclination to link up together for the mutual benefit both of the operator and the customer.

Already there are signs and prophesies that herein lies the ultimate goal of long distance transmission. The time is not too far distant when with the refinements in electrical equipment and control and the developments in transmitting longer distances, many large local areas will be linked up together and served by one mighty system of electric transmission lines, into which each individual plant shall supply its portion of power. To cover the whole of Canada is only a matter of some 4,000 miles and already we transmit in Ontario almost as many hundreds. Even to-day there is the nucleus of just such a mighty net-work in the southern United States which already boasts service lines covering a distance of approximately 1,000 miles. What ten years ago was ridiculous in its impossibility is a commonplace to-day in high voltage transmission and, with the same rate of advance, 4,000 miles in the next decade is far from being an unlikely dream.

Just think what this would mean. The mighty waters of British Columbia, of the Yukon, of the Mackenzie and Nelson, the millions of northern Ontario, the Ottawa, the St Lawrence on to the Hamilton Falls (perhaps our biggest single source of supply)—50,000,000, maybe twice fifty, of hydro-electric horse power feeding into one mosquito-network of transmission lines covering the whole of our Dominion. To say nothing of our coal and gas areas. What other country in the world can look forward to such a future? And this is a source of energy that time will not diminish—it means light and warmth and power in ample supply for hundreds of millions of Canadians for all time to come.

Best Methods of Conservation

At the recent session of the Royal Society of Canada much attention was given to the necessity of best methods of securing the conservation of our natural resources which were defined to be agriculture, the cattle trade, the forest products, the water powers, minerals, fisheries and furs. In his presidential address Dr. Adams stated that we have been blessed with great natural resources but that each and all of these are already showing signs of rapid depletion. While, in the nature of things, this is to be expected of all our mineral deposits, the president pointed out that all our other resources can and ought to be conserved and cultivated so as to yield higher annual returns than at present, increasing in value yearly so that each may be handed over to the succeeding generation in a better and more productive condition than the present one.

Among the more prominent speakers on this subject was Dr. L. A. Herdt who treated more particularly of our water powers and their conservation. He pointed out that conservation doesn't mean hoarding for the use of future generations but means efficient utilization without waste. As an example Dr. Herdt cited the uneconomical production of power using coal as fuel where it is an exceedingly good plant that can utilize 10 per cent of the total energy of the coal, the balance being dissipated as heat or other by-products. On the other hand a hydro-electric plant is now capable of using 70 per cent of the energy contained in the water. It is, therefore, not so much a matter of whether we are able to produce electric energy as cheaply from coal as from water power as it is a matter to be considered that by using coal for power production purposes we actually throw away 90 per cent of one of our exhaustible natural resources. On this basis of calculation even supposing a kw.h. of electric energy can be delivered to the consumer as cheaply by the use of coal as by the use of water it is to be noted that Canada's national wealth in the one case has been reduced by 90 per cent of the amount of coal consumed while in the other case it has not been reduced at all. Extracts from Dr. Herdt's paper are printed elsewhere in this issue.

Grand Rapids Reservation

The Minister of the Interior has authorized the reservation of all the available Dominion lands contiguous to the Grand Rapids of the Saskatchewan River, in the Province of Manitoba, until such time as the Superintendent of the Dominion Water Power Branch is able to make a definite statement respecting the lands actually required for power purposes at this point. During the summer of 1913 an extensive topographical survey of this important power site was made by the Dominion Water Power Branch, to enable the engineers of the government interested in power and navigation to design a scheme of power development which would realize the best use of the power resources of the river without any impairment of future navigation. The hydrographic investigations that have been under way for the last couple of years show that the river varies from 4,200 second feet at low water to about 160,000 second feet at flood tide. While this variation is very considerable it is thought that sufficient regulation can be provided to make a power development at Grand Rapids a profitable undertaking. In any event, the action of the engineers of the Dominion Water Power Branch in having a thorough survey made and in arranging for reservation of the Dominion land required for power shows that conservation is being carried out in practice as well as in theory.

Hamilton Section C. E. A.

The Hamilton Section of the C. E. A. held its final spring meeting on the evening of June 3 in the section room of the Terminal Building, President Dorland in the chair. This was a "Get-Together and Social Night." The meeting was opened with a piano solo by Mr. Maurice O'Toole; Item No. 2 on the programme was a piano and violin duet by Gordon and Earl Harrison, sons of Conductor Harrison, and these numbers received very hearty applause. Other members taking part in the programme were Mr. W. B. Burtch, Mr. Albert Taylor, recitation from Mr. H. Hall, and Mr. Charles Coats, of 179 Sanford Avenue North, sang several songs which brought forth enthusiastic applause. Mr. Coats is a new comer to Hamilton, and he should make a valuable addition to the musical circles of the city. A discussion took place as to the suitable place to hold the annual summer picnic, Mohawk Park, Brantford, being elected. A committee composed of Messrs. Pratt, Hutton, Choate, Lennox and Fry were chosen to make the necessary arrangements and pick out a suitable date. Liquid refreshments in the shape of lemonade were served; also a plentiful supply of cigars. The members all voted that they had had a very pleasant evening. The meeting closed with the singing of the National Anthem.

Storage Batteries in Fire Fighting

At a recent meeting of the Philadelphia section of the Electric Vehicle Association of America, Chief Walker of the Department of Public Safety, in charge of all the fire apparatus of the city, spoke at length concerning the splendid results obtained by their electrically driven fire apparatus and of his efforts to convince the authorities that electrically driven apparatus would be satisfactory.

Chief Walker described an eleven-mile trial trip of an electrically-drawn fire engine over some of the hilliest roads in the hilly section of the city, and stated that the time made on this trip had never been equalled by any of their gasoline-propelled apparatus. He also described a demonstration run in the crowded business section of the city to reach a box which normally required 11 minutes by horses, and which the electrically-driven apparatus reached in 5 minutes and 13 seconds. The Chief related an amusing anecdote concerning some of the "croakers" of his department on viewing the fire apparatus when it was delivered, saying that they never in the world could start the apparatus, and, a few minutes after, seeing the apparatus on the way to a fire, changed their opinion very quickly, and said that "the whole world itself couldn't stop it." In summing up, the Chief expressed himself as being decidedly of the opinion that for the central zones of the city the electrical apparatus was by long odds the most satisfactory.

The Growing Field of the Electric Truck

There are seventy-five different industries in New York city that use electric trucks. Brewers are most largely represented, nineteen separate breweries using a total of thirty-four electric vehicles. The department stores are a close second with seventeen owners and 262 individual cars. The seven express companies have altogether 197 storage battery cars. The bakeries come next with eight users of 161 cars, and the two central stations have between them 150 cars. Electric general delivery wagons number 68 and eight meat packers together use 67 electrics. Five jewelers use 44 electric cars and ten wholesale dry goods stores employ 35. Next to these in number are the 32 delivery wagons owned by the Fleischmann Yeast Company.

While with its 273 owners and more than 1,700 cars New York probably has the largest fleet of electric commercial trucks in the country, Boston, Chicago, St. Louis, Cleveland, Buffalo and Indianapolis are being rapidly electrified. Pittsburg, also, in spite of the hills, is among the cities with a growing fleet. Five two-ton trucks were shipped this week to the Duquesne Light Company, which already had two light delivery wagons. An effective advertising sign on these Duquesne trucks is the slogan on the battery boxes, "You can do it better with electricity."

N. E. L. A. Convention

The recent convention of the National Electric Light Association held in Philadelphia, June 1-5, is considered the most successful in the history of this association's 37 years existence. The attendance was over 4,000. The most important event was the public policy meeting on Wednesday evening at which such well known guests as Thomas Edison, Charles Brush, and Frank Sprague were present. Mr. Frederic Nicholls, president and managing director of the Canadian General Electric Company was also among the guests. During the convention the interesting announcement was made by Mr. J. M. Wakeman, general manager of the society for electrical development, to the effect that the necessary $200,000 had been pledged for their advertising campaign. At the same time Mr. Wakeman pointed out that this society was not receiving the support it deserved from the central stations.

The Montreal Public Service Corporation have made a competitive offer to that of the Montreal Light, Heat and Power Company for supplying electric light to the city in the districts where underground distribution has to be made in consequence of the building of conduits. The Public Service Corporation's price per lamp, under a six-year contract, is $137 per annum, the company supplying all equipment; under a 16-year contract the price will be $88; the latter price to be reduced to $65 if the city supplies the standards, cables, etc.

The Artistic in Power Buildings

A number of interesting letters have been received in connection with our recent editorial on "ugly power buildings."

Throughout these letters the sentiment has been uniform, that sufficient attention is not given to the architecural design of our elecric buildings. At the same time the opinion is equally uniform that a marked improvement can be effected without additional cost where a proper co-operation and understanding exists between the engineer and the architect.

One of the most interesting letters has been received from Mr. G. R. G. Conway, chief engineer of the British Columbia Electric Railway, whose work along the line of beautifying the exterior of power buildings of this company is being very much appreciated in the coast province. We print Mr. Conway's letter herewith and reproduce also a photograph of their newest hydro-electric power house, one of the most beautiful on the continent in point of simplicity, dignity and proportion.

Editor, "Electrical News," Toronto:

I have read with interest the leading article in your issue of the 15th May with reference to ugly power buildings. The writer has long advocated that there should be greater co-operation between engineers and architects in the matter of the design of buildings connected with engineering projects which are of semi-public importance. Engineers, although primarily dealing with the utilitarian side of things, however, have no right to design these buildings alone, and their architectural attempts generally lead them to load their structures with architectural decoration which they do not understand. It takes the modern engineer the greater part of a busy life to master even one branch of his profession, and it takes the whole of an architect's life to understand his art. We should therefore advocate in season and out of season the co-operation of engineers and architects in the design of engineering works; these works are primarily for the use of the community, and in many cases, such as the building of great masonry dams for storing water for power purposes, where structures are built which may last for many centuries, the engineer has no right to inflict ugliness upon the present and coming generations, especially as a fine design is often a question of beautiful proportions and generally costs no more to construct than an ugly one, and not infrequently costs less.

Beautiful power-house design as exemplified in the Lake Buntzen plant of the B.C.E.R. Co.

We see this co-operation of engineers and architects in the design of many beautiful bridges, and in some of the great terminal railway stations on the American continent and in Europe, and I think that this co-operation should be carried out to a much greater extent in the designing of power houses than it has been in the past.

As an example of carrying these principles into practice, I am enclosing you a photograph of the new power house at Lake Buntzen for the British Columbia Electric Railway Company, where the architect and engineer have co-operated together with excellent results. The architectural treatment of the building was designed by Messrs. Somervell & Putnam, of Vancouver, and the building, which is at the water's edge with a background of high mountains, can be seen for six or seven miles by all people who are travelling up the North Arm of Vancouver Harbour.

There is no reason at all why we cannot have beautiful designs for the buildings and chimneys of a steam power plant, or for a hydro-electric plant, but we should, though, in every case make these structures express in the design their real function, stating plainly without pretension what they represent. We do not want a steam plant chimney to resemble Cleopatra's Needle, or a power house to look like a temple for the worship of Minerva, but we should, out of politeness to the public, build them with more beauty than the average factory or workshop. The true solution of the question is in a wise co-operation of the two professions—then, and then only, can these structures be made worthy of being called beautiful.

Yours faithfully,
G. R. G. Conway.

Vancouver, B.C., May 28, 1914.

Layer Insulation in Transformer Construction

It is claimed by some designing engineers, that insulation other than the cotton braid, or enamel on the wire, combined with the forced in compound, is sufficient to stand the combined mechanical and electrical stresses which occur at ordinary operating conditions of pole type Transformers.

Windings without layer insulation bring each individual cotton or enamel insulated wire of a given turn in physical contact with from two to six other turns, depending on the location of the turn in the winding. The contact between the turns is very positive, and the tension of each layer above adds to that beneath, so that the lower layer is under comparatively high mechanical stresses. In windings with layer insulation, the maximum number of mechanical contacts between a given turn, and adjacent conductors, is two, and these two contacts are with turns of the same layer. Consequently, neither the mechanical or the electrical stresses are severe.

The normal electrical stresses in a transformer without layer insulation varies from approximately 3 volts between turns in the same layer to 100 volts between adjacent turns in the adjoining layer. Layer insulation is an additional barrier between the adjacent turns in adjoining layers, and therefore limits the electrical stresses between adjacent turns to the difference in potential between the adjacent turns in the same layer, or approximately 3 volts.

The omission of layer insulation gives a greatly reduced safety factor, and will undoubtedly result in shorter lived transformers, than a design equally good in other respects, using layer insulation. Tests have proven that a transformer wound with layer insulation will break down under induced high potential of approximately fifteen times normal potential, and when wound without layer insulation, at five times normal potential, or in other words the layer insulation affords three times the protection between turns.

Transformer failures, after several years of service, are usually due to the wearing out of the insulation between adjacent turns of adjoining layers; therefore, additional insulation at this point naturally increases their life. The following tabulation will show the preference that should be given to transformers that will give long life.

Assume the following conditions

5 kv.a., 60-cycle, 2200 volt primary, 110/220 volt secondary.

Transformer

Core loss	45 watts
Copper loss	93 watts
First cost	$50.00
Interest	5 per cent.
Depreciation	5 per cent. for 20-year life
Depreciation	10 per cent. for 10-year life
Cost of station equipment ...	$150.00 per kv.a.
Cost to produce energy expended in core loss	.01 per kw.h.
Cost to produce energy expended in copper loss ...	.02 per kw.h.

Cost, based on 20 years

Annual cost of operation, based on 20 years life:—

Core loss—.045 x 24 x 365 x .01 ... ... = $3.94

Copper loss—.093 x 4 x 365 x .02 ... ... = 2.72

Interest at 5 per cent. ... ... = 2.50

Depreciation at 5 per cent. ... . = 2.50

Station investment for total losses, $150.00 x .138 x 10 per cent. (depreciation of station taken at 10 per cent.) ... ... = 2.07

Total annual cost ... ... = $13.73

Cost, based on 10 years

Annual cost of operation, based on 10 years life:—

Core loss—.045 x 24 x 365 x .01 ... ... = $3.94

Copper loss—.093 x 4 x 365 x .02 ... ... = 2.72

Interest at 5 per cent. ... ... = 2.50

Depreciation at 10 per cent. ... ... = 5.00

Station investment for total losses ... ... = 2.07

Total annual cost ... ... = $16.23

The above tabulation shows that, under the conditions specified, a transformer that will give twenty years life, will save $2.50 per year to the purchaser, over a transformer having the same initial cost and losses, but having a total life of ten years. In other words, a purchaser could afford to pay 50 per cent. more for the twenty-year transformer and still save the extra cost replacing the short lived transformer in service, plus additional costs due to interrupted service.

D. C. Shunt Motor on A. C. Lines

Why won't the direct current shunt motor operate on alternating circuits?

This question has probably been more or less hazy in the minds of operating engineers and men in charge of electrical equipment, specially those who had not given the subject any special study.

Granting that it is clearly understood that a direct current flows continuously in one direction, while the alternating current goes through cycles of changes in direction of flow in very rapid succession, the main reason for the unsatisfactory, or failure of, operation of the d.c. shunt motor on a.c. will be apparent after the following non-mathematical reasoning is digested.

The direction of rotation of a direct current motor is independent of the direction of the current supplied to it. That is, rotation will be in the same direction, even though the current flow is reversed in direction. Theoretically, therefore, any direct current motor should operate on alternating current. But, the important essential is, that the current in the armature and field reverse simultaneously. This is where the shunt motor on a.c. falls down.

With direct currents there is no phase relation of any kind. With alternating currents there is always some phase relation depending upon the impedence in the circuit. With alternating current applied to the shunt motor then, having its armature and field in parallel, we find that the current through the armature is not in phase with the current through the field. As a matter of fact the field current is lagging nearly 90 per cent. behind, due to the high inductance of the many turns of field winding. All the ordinary forms of shunt motors have a high inductive winding.

This "out of phase" relation of the armature and field currents is the only objection in trying to run a shunt motor with a.c., for the following reason:—The ability of a motor to do work depends upon the torque that it can produce. In the shunt motor, the torque results from the repelling action of the stationary field flux and the armature flux, produced by the field current and armature current respectively. It is absolutely essential that there is some field flux and armature flux in one direction at every instant of time, to produce a continuous torque. With direct current this is always so, since there is no change in the direction of current. But, with alternating current this is not so, since the current through the field and armature is reversing continuously and in the shunt motor, with the field flux 90 deg. or one-quarter of a cycle behind the armature flux, the field flux is maximum when the armature flux is zero and the armature flux is maximum when the field flux is zero. It is readily seen then that the essential condition mentioned above is not fulfilled when a.c. is applied to a shunt wound motor, and therefore no appreciable torque is available for doing work satisfactorily.

To overcome the objection of the "out of phase" relation between the armature and field current, the field may be separately excited from a source differing 90 deg. in phase from another source supplied to the armature. That is, the field could be fed by one phase and the armature by the other phase of a two-phase system and in that way the armature current brought approximately into phase with the magnetic flux of the field. Torque would then be produced the same as if direct current were used. However, there would probably be the additional objection of sparking at the commutator due to induced currents when running on a.c., which could not be overcome conveniently and could only be eliminated by a special design such as is incorporated in a.c. series motors used for electric traction, crane and rolling mill service, etc.

Besides, the iron losses due to eddy currents in the field poles of a d.c. motor on a.c. would be comparatively high, because the poles would not be laminated. A.c. motors are always constructed with laminated rotor and stator iron, on that account.

Ordinarily, no attempt would be made to operate a shunt motor on an a.c. circuit for economic reasons, for it would surely be a great deal cheaper eventually to purchase an a.c. motor than to go to the trouble and expense of trying to arrange a suitable means of using a d.c. motor on a.c. Even the ordinary d.c. series motor would not prove entirely satisfactory on an a.c. circuit, on account of commutator troubles that would be inherent, and other features requiring a.c. design.

The annual report of the New Brunswick Telephone Company shows gross earnings of $422,709 and net revenue of $81,327. The number of telephones now in use in the province of New Brunswick is 14,519, an increase of 1,604 during the past year.

Canadian Electrical Association Convention

Program of the Twenty-Fourth Convention, being held in Montreal, at the Ritz-Carlton, June 24, 25, 26

Preparations are about completed for the twenty-fourth annual convention of the Canadian Electrical Association, which will be held in Montreal on June 24-25-26, with headquarters at the Ritz-Carlton Hotel.

No more appropriate place than Montreal can be found in Canada for the meeting of electrical men, as Montreal next to Niagara Falls may now be looked upon as the largest power centre in Canada. The power situation in Montreal is in the hands of two progressive private corporations. The Montreal Tramways Company through the Public Service Corporation control the street railway system, the generating plant of the Canadian Light & Power Company and a number of smaller electric companies which formerly operated as individual concerns but have now practically lost their identity in the parent organization. The power and light supply is almost entirely in the hands of the Shawinigan Water & Power Company, who generate, and the Montreal Light, Heat & Power Company who distribute and with these is intimately associated the Cedars Rapids Manufacturing & Power Company whose plant is at present under construction. With the completion of this latter plant the total amount of electric power developed in the neighborhood of Montreal will approximate 400,000 h.p.

The papers programme which promises to be productive of much interesting and useful information is given herewith, as is also the very attractive-looking programme in store for the ladies. The Electrical Fraternity of Montreal evidently intend to uphold their reputation as good entertainers.

PROGRAMME OF PAPERS AND REPORTS

Wednesday, June 24th

10.00 a.m. Opening Session.
President's Address.
Secretary-Treasurer's Report.
Report of Auditors.
Correspondence.
Reports of Committees.
"Modern Switching Equipment"—L. B. Chubbuck, Canadian Westinghouse Co.

2.00 p.m. "The Legal Aspect of Interference Between Systems of Electrical Companies"—G. H. Montgomery, K.C., Brown and McMichael.
"Safety First"—J. F. H. Wyse, Organizer & Engineer of the Ontario Safety League.
"Grounding of Distribution Circuits"—S. B. Hood, Toronto Electric Light Company.

Thursday, June 25th

9.30 a.m. "The Value of Electric Heating Devices to the Central Station"—Harold S. Brown, Canadian General Electric Company.
"Co-operation in the Selling of Heating & Cooking Appliances"—W. B. Johnson, Montreal Light, Heat & Power Company.
"Maximum Demand"—P. T. Davies, Montreal Light, Heat & Power Company.
"Report on Work of N.E.L.A. Meter Committee"—G. W. Magalhaes, Toronto Electric Light Co.

(Mr. Magalhaes is also arranging an interesting exhibit of demand watt-meters).

2.00 p.m. "Notes on Electrification of Steam Railways"—J. A. Shaw, Canadian Pacific Railway Company.

Friday, June 26th

9.30 a.m. "Interruptions on Long Distance Transmission Lines, their origin and means of prevention"—P. Ackerman, Toronto Power Company.
"High Efficiency Incandescent Lamps and Their Application"—H. H. Magdfick, General Electric Company.
Held over papers and discussions.

2.00 p.m. Executive Session—Election of officers, etc.

ENTERTAINMENT PROGRAMME

Wednesday, June 24th.

10.00 a.m.—Civic Reception at Ritz-Carlton.
11.15 a.m.—Ladies to Country Club, St. Lambert.
1.00 p.m.—Lunch at Country Club.
4.00 p.m.—Tea on R.M.S. "Ascania" Cunard Line.
Boat Races and Life-Saving demonstrations.
9.00 p.m.—Smoking Concert at Ritz.

Thursday, June 25th

10.00 a.m.—Visits to places of interest.
Bell Telephone Exchange.
Mountain Top.

3.00 p.m.—Cars to Lachine.
Down Rapids to "Duchess of York."
Visit to Harbor.
Visit to Vickers Dry Dock.

7.30 p.m.—Dinner at Dominion Park.
Return by M. S. R.

Friday, June 26th.

10.00 a.m.—Shopping.
2.00 p.m.—Ladies and gentlemen cars to St. Cesaire, guests of Southern Counties Railway.
5.00 p.m.—Tea at Ritz-Carlton, Souvenirs.
8.00 p.m.—Theatre Party, Princess Theatre.

LOCAL COMMITTEES

Montreal Local Committees have been appointed as follows:—

General Committee:—Major Hutcheson and Mr. J. S. Norris, Joint Chairman, Messrs. L. D. McFarlane, E. F. Sise, G. H. Olney, R. S. Kelsch, R. J. Jones, J. M. Robertson and Dr. L. A. Herdt.

Ways and Means Committee:—Mr. Julian C. Smith, Chairman, Messrs. K. B. Thornton, J. A. Shaw, R. H. Balfour, W. F. Graves and R. F. Morkill.

Entertainment Committee:—Mr. Lawford Grant, Chairman, Alderman Boyd, Messrs. Paul Sise, R. G. Harris, W. C. Lancaster, W. H. Winter, H. C. Post, P. Roper, Powell and R. M. Wilson.

Publicity Committee:—Mr. S. W. Smith, Chairman, Messrs. W. J. Doherty and L. J. Belnap.

Finance Committee: Mr. J. W. Pilcher, Chairman, C. F. Medbury, F. W. Smith, R. M. Wilson and L. J. Belnap. P. T. Davies, Hon. Secretary.

Montreal a Centre of Electric Activity

Brief Description of the Chief Features, Including the Cedars Rapids Manufacturing and Power Plant Construction to Date

Work on the new hydro-electric development of the Cedars Rapids Manufacturing & Power Company on the St. Lawrence River is progressing rapidly, and the company expect to be in a position to generate power by December next.

This development, when completed, will be the largest low head proposition in Canada. The development is located at Cedar Rapids, on the north shore of the St. Lawrence River, some thirty or thirty-five miles west of Montreal. The location of the development is ideal owing to the fact that a full supply of water is available at all times and seasons of the year, the company having the right to the necessary water supply for the full contemplated development at all times. The amount of water taken for the full development will in no way affect navigation.

The present development will be for 100,000 horse power and the final development 160,000 horse power. The head available on the turbines will be thirty feet. Contracts have been made for the sale of the total available supply of power of the first development, so that the company will be in a very favorable position from the start. The design and construction of the development have been made with the utmost care, the main object being to secure continuity of operation.

The work is of considerable magnitude and covers a great deal of ground, the distance from the entrance works to the end of the tail race being approximately two miles. In Fig. 1, which shows a plan view of the development, the main features may be seen. The water enters a canal, which is some 12,000 feet long, at the end of which, at right angles, stands the power house, the substructure of which acts as a dam giving an effective head of thirty feet on the turbine wheels. The power house contains only the generating equipment, the transformers and low tension bus-bars and high tension switching apparatus being housed in the step-up-transformer house.

The construction of the canal or head race has entailed considerable excavation work, necessitating the removal of some 1,500,000 cu. yds. of earth and 600,000 cu. yds. of rock. This excavation is being done in the dry, being accomplished by sinking a crib dam along the southern boundary of the development. The crib continues down and around the end of the tail race. The south bank of the canal is a rock and earth filled dam. A typical cross-section of this dam is shown in Fig. 2. This bank extends from Isle aux Vaches at the upper end of the development right down as far as the power house and has been formed by means of dumping the material excavated from other portions of the work. The north bank of the canal is formed by means of dumping earth along the shore line bringing the river bank up to the necessary elevation to avoid flooding of the country north of the development when the water is let into the canal. In order to take care of the drainage area immediately north of the development a large ditch has been excavated along the northern boundary of the company's property at some little distance back from the north bank. This ditch drains directly into the tail race.

In the south bank two ice sluices have been located, one about 3,000 ft. from the entrance of the canal and the other at the power house end. These have been provided to get rid of floating ice, and are formed by a series of concrete piers with overflow weirs in between. The openings between these piers above the overflow weirs will be filled in with stop logs.

The power house, which stands at the end of the canal, consists of a substructure of reinforced concrete, on which stands a superstructure built of steel and reinforced concrete. The total length of the power house for the first development is about 663 ft. Fig. 3 shows a typical cross-section of the power house, and it will be noted from this that the substructure has been so designed as to embrace the

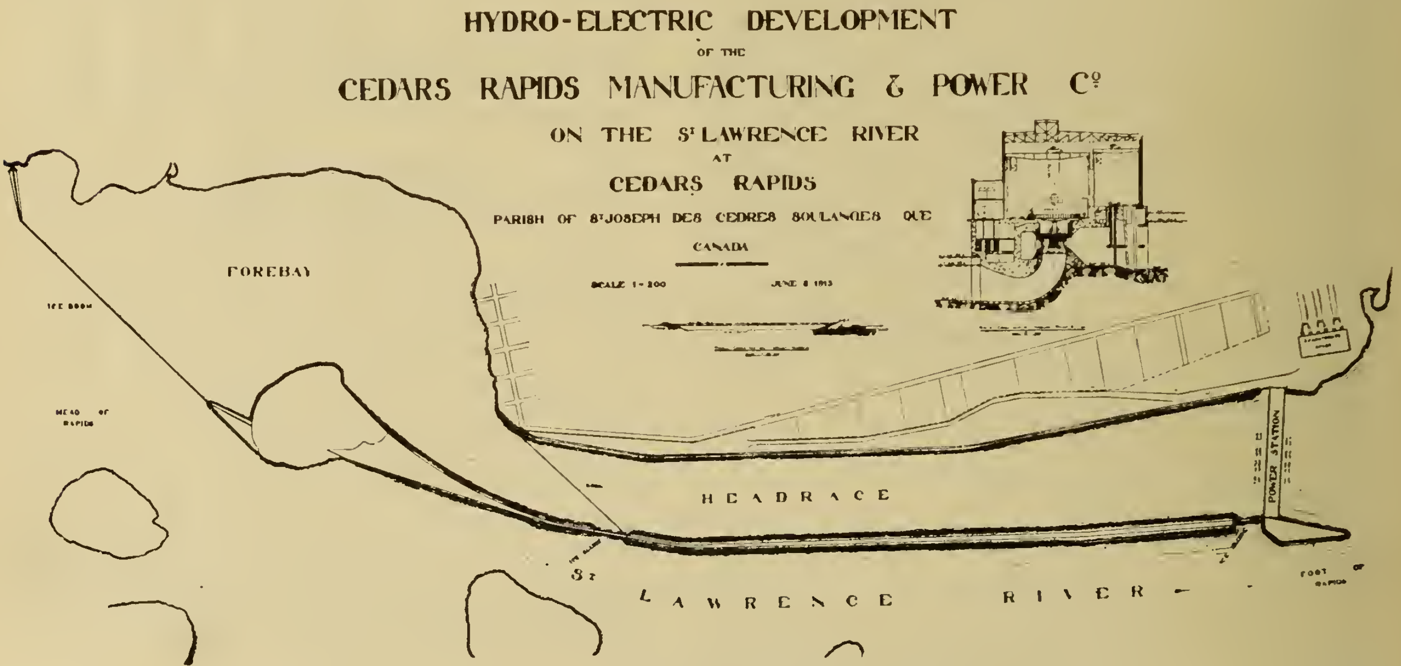

Fig. 1.—General plan of Cedars Rapids Manufacturing and Power Company's Development.

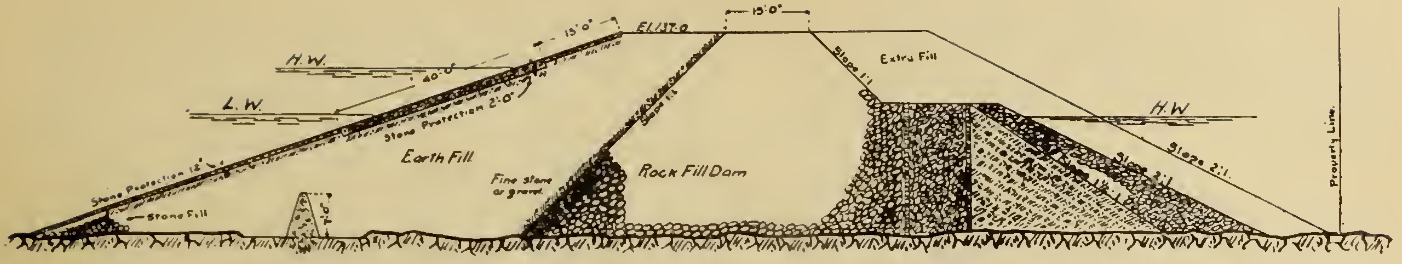

Fig. 2—Typical cross-section of dam at south bank of canal—Cedars Rapids Mfg. and Power Co.

water passage for the turbines. Water flows through these passages to the turbine runner and from there is discharged downwards through the draft tube into the tail race, excavation for this latter having been continued about one thousand feet from the power house, the grade rising gradually from the end of the draft tubes.

The generating equipment in the power house for the first development will consist of 9-10,800 h.p., 56 r.p.m., single runner vertical inward flow turbines, and to each of these turbines will be connected a 10,000 kv.a., 3-phase, 6,600 volt, 60-cycle vertical generator of the revolving field type. There are also three 1,500 h.p. turbines of the same type as the large units and having a speed of 150 r.p.m., and to each of these is attached a 1,250 kv.a., 3-phase, 2,300 volt, 60-cycle, vertical water-wheel driven generator of the same type as the larger units. Three of the 10,800 h.p. turbines are being supplied by the Wellman, Seaver, Morgan Company, Cleveland, Ohio, and the remaining turbine equipment by the I. P. Morris Com-

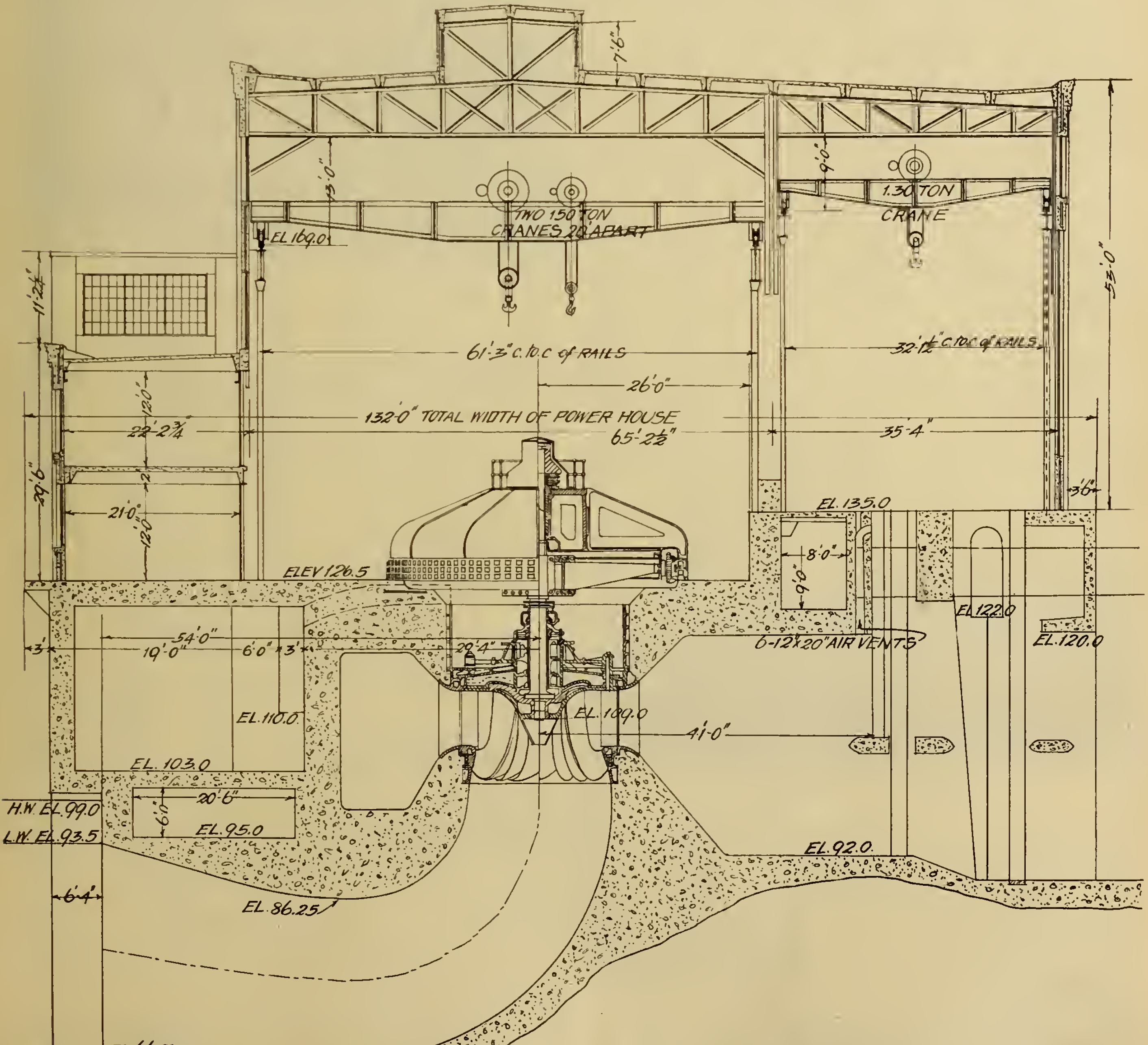

Fig. 3—Section of Cedars power-house—Generator and turbine on same shaft, suspended from bridge above generator stator.

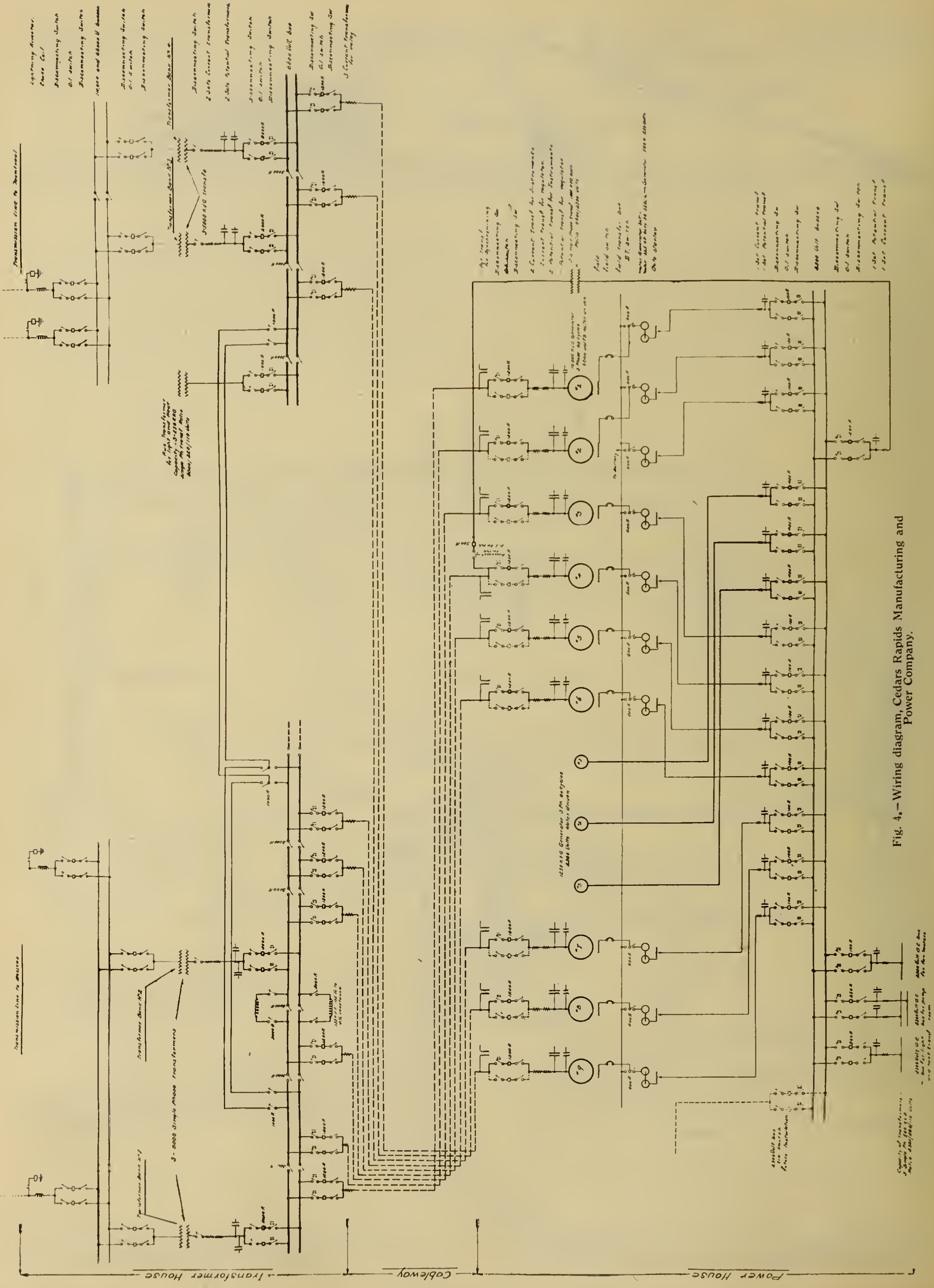
Transmission line to Montreal
Transmission line to Massena
Transformer Bank No. 2
Transformer Bank No. 1
3 - 6000 Single Phase Transformers
Transformer House
Cableway
Power House

Fig. 4.—Wiring diagram, Cedars Rapids Manufacturing and Power Company.

pany of Philadelphia. This latter company is also furnishing the governors and governor pumping equipment, which consists of four 250 h.p. centrifugal pumps and accessories. In both the 10,800 h.p. and the 1,500 h.p. units the shaft of the generator and turbines is in one piece, the weight of the rotating mass being carried on a Kingsbury thrust bearing, which is supported on a bridge carried on the generator stator. The turbine speed ring is so designed that this weight is transmitted through it to the concrete foundation below.

The generating apparatus is being furnished by the General Electric Company of Schnectady, N.Y. An interesting feature about the arrangement of the plant is the fact that each 10,000 kv.a. generator has its own individual motor-generator exciter set. These motor-generator sets are driven by 225 h.p. motors, which receive their supply of power from the 1,250 kv.a. generators. The generators of the exciter sets are of 150 kw. capacity supplying direct current at 250 volts to the fields of the main units. The exciter voltage of each set is controlled automatically by means of a Tirrill regulator. The 1,250 kv.a. generators receive their excitation from exciters connected directly on the generator shaft.

Speed rings, main and exciter units—Cedars plant.

Arrangements have also been made for the installation of ventilating equipment in the power house of such capacity that 35,000 cu. ft. of air will be delivered to the wheel pit of each main generator. This ventilating equipment will consist of five sets of fans taking the air through the tail race wall of the building and discharging into an air chamber in the substructure of the power house, from which ducts lead to the wheel pit of each unit. The fans will be driven by 2,200 volt, 3-phase induction motors.

The step-up transformers and low tension bus-bars as before mentioned will be located in a separate building. This building will be of reinforced concrete construction and will be situated approximately 250 ft. from the end of the power house and about 850 ft. from the end of the power house for the present development. Provision has been made in this transformer house for four transformer banks. Two of these banks will be of 24,000 kv.a. capacity, each bank being made up of three 8,000 kv.a., single-phase, 6,600 volt, to 110,000 volt transformers. The other two banks will be of 15,000 kv.a. capacity, each bank being made up of three 5,000 kv.a., single-phase, 6,600 volt to 66,000 volt transformers. The 24,000 kv.a. banks will feed transmission lines running from the development to Messina, N.Y., where 60,000 h.p. will be utilized. The remainder of the power will be transmitted to Montreal by means of transmission lines fed from the 15,000 kv.a. transformer banks. The low tension bus-bars and transformer switchgear for low tension and high tension sides are also located in this transformer house.

Fig. 4 shows the wiring diagram for the development. The switchboard equipment for the plant is divided into three sections, as follows:—

(1) Main control desk in the power house for control of the 10,000 kv.a. units.

(2) 2,300 volt switchboard for control of the 2,300 volt units and accessories.

(3) Control desk and instrument panels in the transformer house for control of the transformer switchgear.

From the main control desk in the power house will be controlled all the oil switches on the main generator circuits, also the electrically operated rheostats and field switches for these circuits. On the back of this control desk the instruments on the generator circuits will be mounted; these instruments are all of the indicating type, except that for each circuit an integrating wattmeter is provided. Signal devices are also provided on this board for interchange of signals between the operator and generator room floor-men.

The 2,300 volt switchboard is of the vertical type, and controls the 1,250 kv.a. exciter generators. The control for the various 2,300 volt circuits in the power house is also on this board. The Tirrill regulators for the automatic control of the 150 kw. exciters are mounted on the induction motor feeder panels, which control the 225 h.p. motors driving these exciters. On the transformer house control board are situated all the controllers operating the oil-switches on the transformer circuits. The transformer instrument panels will be separate from the control desk, and on them will be mounted indicating, graphic and integrating meters for the measurement of the power output of the development. Relays will also be mounted on these panels for the automatic operation of the oil-switches on the transformer citrcuits and also for the generator bus oil switches, which are located in the transformer house, but which are remote controlled from the main control desk in the power house.

Cedars power-house—Up-stream side.

An interesting feature concerning the low tension switch gear of this development is that though the normal operating voltage will be 6600 volts the oil-switch installation has been designed for 13200 volts, as is also the 6600 volt cable work. Similarly the oil-switches on the 2300 volt circuits are designed for operation on 7500 volts, and cable work will be insulated for 4400 volts. The contract for the switchboard equipment and low tension switchgear has been awarded to the General Electric Company of Schenectady, N.Y. In the power house there will be a bank of auxiliary transformers of 3,000 kv.a. capacity, made up of three 1000 kv.a., single-phase, 6600 volt to 2300 volt, water-cooled transformers. This bank will be fed from one of the main generating circuits and will feed on to the 2300 volt busbars to act as spare capacity in case of a shut down of one or more of the 1250 kv.a generators. Auxiliary transformer banks giving low voltage energy for light, heating and power have been provided in both power and transformer houses.

Another interesting feature of the development and one which has been studied with great care is the feeder cable installation between the generator switches in the power house and the low tension bus-bars in the transformer house. The current from each main generator will be carried to the low tension bus-bars in the transformer house by means of four three-conductor 300,000 c.m. paper-insulated, lead-covered cables, installed in ducts. Special care will be taken to provide a thorough separation between individual cables in order to avoid any danger from a break-down on one of the cables affecting cables of the same or of another circuit. These cables will be protected at the transformer house end by means of relays operating the generator bus oil switches.

The power house will be equipped with two 150-ton cranes for handling the generators and turbines and in the gate room will be installed a thirty-ton crane for handling the gates and racks. A 40-ton travelling hoist will be provided in the transformer house for handling the transformers.

The work at the present time is in an advanced state as will be noted by referring to copy of the last progress report issued by the company on December 1st, 1913. The following are the quantities which have been involved in the construction of this work and which give a good idea of the size and magnitude of this development.

Earth excavation	1,620,000 cu. yds.
Rock excavation	700,000 cu. yds.
Concrete in power house substructure	81,500 cu. yds.

The first work on the development was started in May, 1912, when the crib work on the outside of the south bank was commenced, so that it can be seen that the progress which has been made is remarkable when the difficulties which have been encountered are considered. The work of design and construction has been carried on under the supervision of Mr. Julian C. Smith, vice-president and chief engineer of the Shawinigan Water & Power Company, as hydraulic engineer, and Mr. R. M. Wilson, chief engineer of the Montreal Light, Heat & Power Company, as electrical engineer.

Electrification of the Mount Royal Tunnel

By W. C. Lancaster, C.E., M.E., Fellow A.I.E.E., Member A.S.M.E.*

The Canadian Northern Railway when completed during the present year will be the second transcontinental system to be operated in Canada and will have a total track of more than 10,000 miles. Most of this mileage is in the provinces of Alberta and Saskatchewan, from whose vast grain fields is drawn the traffic which has made the harbor of Montreal the second in importance on the American continent. On this new route from Montreal to Vancouver the grain traffic in a single day often amounts to more than 1,000,000 bushels of wheat. With Montreal the destination for most of this enormous and ever-increasing traffic, it became necessary to provide terminal facilities adequate to prevent any possibility of congestion.

In the absence of a map I will endeavor to describe the electric zone of the Tunnel and Terminal. Starting with the Dorchester Street Terminal as the eastern boundary, the tracks run under the Mountain ascending a .6 per cent. grade all the way. Emerging at the West Portal we find the Model City coach yard and the depressed tracks through that city. West of Model City boundary is located the Quebec Junction with also the crossing of the Jacque Cartier Union Railway, and the Quebec engine change sidings.

At Quebec Junction the Canadian Northern Ontario tracks join those from the tunnel and proceed to Cartierville. Here the trains for the West or vice versa change power. At Cartierville is located the new classification yard which is to be partially electrified. Here also will be located the electric repair and inspection shops. The zone thus defined constitutes about nine route miles of double track. This with sidings and considerable trackage in yards is to be arranged for electric engine operation.

The electrification is unique in that it is not the electrification of an existing time table based upon present steam operation. The engineering calculations have all been based upon a hypothetical foundation prepared from a careful and exhaustive study of train movements, the number of passengers travelling, express and freight traffic statistics, and other factors entering with a terminal study. This examination of Montreal terminals and general Canadian inter and intra province as well as transcontinental passenger travel produced statistics from which the Canadian Northern was able to estimate, with due conservatism, its share of the railroad business originating in, as well as that to terminate in Montreal.

With such an estimate reached and decided upon, a tentative initial schedule was prepared and train weights assumed consistent with modern equipments.

A study of the schedule with respect to the most suitable electric propulsion power resulted in a choice of 2400 volt direct current. Single phase alternating current at 11000 volts and 25 cycle periodicity was considered carefully and dismissed, principally because of the higher initial cost of total installation, due to the combination of the necessity for frequency changer sets and for the high cost of motor coach equipment, which items are a very considerable percentage of the whole investment. Three phase and single phase-poly phase systems were found to be not suitable, because of their inherent motor characteristics of speed; this alone, if the complication of the overhead in the one case, and cumbersome speed control apparatus in the other case were not sufficient reasons for dismissal. The use of the mercury arc rectifier was in a state of experimentation too unstable for serious consideration.

Having determined upon the use of 2400 volts propulsion power, and in reaching this decision very serious consideration was given to its adaptability to future extensions, it may perhaps assist in the explanation of the details of the electrification to travel with the current from its source through its various paths to its return to the source.

A careful canvass of the power supply available on the Island of Montreal or within the scope of a moderate transmission line mileage seems to show that power at 11000 volts and 60 cycle periodicity can be purchased with an assurance of continuity. This assurance of continuity is an equal factor to the consideration of price. We congratulate the travelling public and ourselves, upon the abundance of power developments available. So abundant are they that the railroad company is relieved of erecting a stand-by station of its own—be it by steam or water. For the generation of power as well as for stand-by purposes, steam as well as water stations entered into the engineering calculations.

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The power will be brought into the terminal sub-station located directly outside of the West Portal of the tunnel, through cables in duplicate running in ducts through the center wall of the tunnel from the Dorchester Street terminal.

In this sub-station the switching is so arranged on the vertical 33 panel switchboard that any incoming line will feed directly to a duplicate set of high tension busses. This switchboard has the usual complement of meters and switch gear, wattmeters, and Tirrill regulator. Provision is made for the installation of an additional main unit set, and its auxiliary circuits, by boards drilled and buttoned. The switchboard controls: a 3.5 kw. motor-generator set for charging battery; station lighting and emergency lighting; auxiliary apparatus transformers; incoming lines, a.c.; outgoing lines, a.c.; exciter sets; traction motor-generator sets; 2400 volt d.c. feeder circuits; electric zone signal mains; tunnel lighting.

The 2400 volt d.c. circuit-breakers are mounted above and to the rear of the operator's position in front of the board, thus providing safe arcing room. These circuit-breakers rupture the circuit in air direct and do not introduce any limiting resistance.

From the busses the power is led to each of the three-phase starting compensators for the main unit motor-generator sets. These compensators are self contained auto-transformers immersed in oil. The main unit sets are two in number for the initial equipment. Space for a third set is provided, to be occupied when traffic shall demand, and the station is so designed that a fourth machine could be installed by a unit addition to the length of the building. The installation of the fourth set seems very remote, however.

These main unit sets each consist of a three unit-four bearing set, mounted upon a common base with the motor between the generators. This is a synchronous motor rated at 12 poles, 2100 kv.a., 600 r.p.m., 11,000 volts, designed for 80 per cent. power-factor running. The two generators of these sets are each rated 6 pole, 750 kw., 600 r.p.m., 1200 volts. This rating is their continuous rating. They are also rated at 150 per cent. load for two hours and have a five minute rating of 300 per cent. load. The two generators are connected in series with their exciting fields connected to the low potential side of the circuit. Each generator while designed for 1200 volt generation is thoroughly insulated against 2400 volt stresses.

The exciting main poles have a compensating winding in the pole face in series with the commutating poles through which current always flows and the purpose of which windings is to neutralize the severe armature reaction arising from heavy over-loads. With this assistance to the commutating poles the proper commutation of the generators is assured.

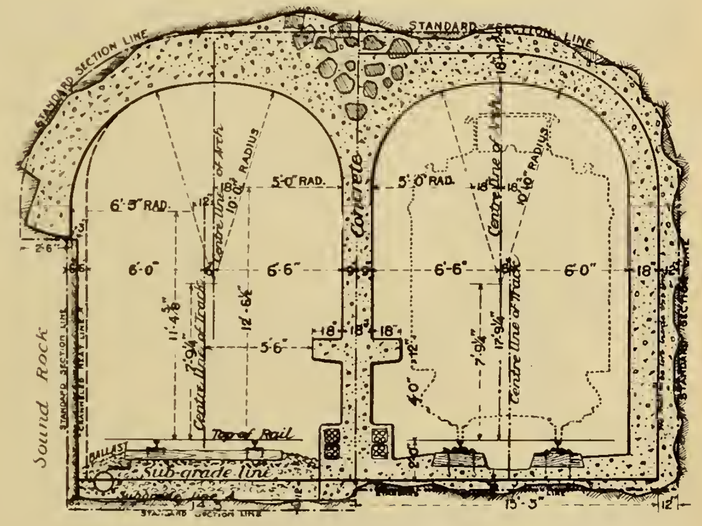
Each main unit is provided with an induction motor-generator exciter set. These sets are rated at 50 kw. on the d.c. generator end and are driven by 75 h.p., 550 volt squirrel cage induction motors. Power for these exciters is stepped down from the 11,000 volt busses. There are three exciters provided with one in reserve as spare. These exciters are specified, one to care for two synchronous motor fields and the other one to supply the four generator fields when the two main unit sets are each generating 1500 kw. Each exciter set has an overload capacity sufficient to supply all the excitation for two main unit sets, when emergency should so demand.

The propulsion current is carried to the 2400 volt busses from which the feeder circuits receive their power.

In reviewing the sub-station a word should be said about the building.

It is a reinforced concrete and brick building with steel roof trusses. The face brick is that of tapestry with raked joints. Special attention was given the architecture of this building to conform to the standards set up for buildings in the Model City. The main machine room has a floor area of 4,000 square feet. Back of the room and on the same floor are the bus room, feeder room and the power transformer room. Above these are the oil switch room, the lightning arrester room and the signal and lighting transformers. On the third floor is located the oil switch control batteries.

From the sub-station the power feeds through cable in conduits to the depressed tracks and from thence, runs to the overhead contact circuit. This circuit is designed as a simple catenary system throughout the zone. A steel messenger cable will carry the copper contact wire from the West Portal through to Cartierville. Due to the very low height of contact wire, a condition imposed by the many bridges through the Model City, this wire will be paralleled by a second copper contact wire, the two suspended from the messenger cable. This second wire is provided as additional weight with which to counteract the upward pressure of the pantograph. The pole spacing will be 150 feet on tangent track and as the curvature is not in excess of 2 deg. anywhere on the line, approximately 125 ft. will be the minimum spacing.



Typical tunnel section.

It is not denitely decided whether a reinforced concrete pole or wood poles of selected cedar will be used. In some cases cross catenary spans will be required, but most of the line will be hung from the familiar "T" iron bracket.

Feeders of bare 250,000 c.m. copper cable will be strung, one cable on each side of the right of way.

In order to obtain at all times and through all temperature ranges, certain predetermined tensions upon the contact wire, a system of anchorages has been designed with automatic tension regulators consisting of weights attached to chains run over sheaves and through insulators attached to the contact wires.

In the tunnel where low clearances are necessary the same double contact wire is to be strung. However, the tunnel catenary cable will not be of steel. Rather than lay feeder cable in conduit in the tunnel it has been decided to string a 400,000 cm. copper cable, as the catenary messenger, which will provide the necessary feeder capacity in parallel with the two 4/0 contact wires. It is possible that an aluminium cable with a steel center strand and of a cable cross-section equivalent to a copper cable of 400,000 cm. may be used. An investigation of its physical properties when acting as a catenary messenger is now under way. Considerable first cost can be saved if it proves acceptable. In the terminal, the use of a catenary system is doubtful economy because of the intricate pantograph defection work required. An overhead rail perhaps may prove available This detail has not been decided upon.

From the contact wire the current is taken for the propulsion of both cars and locomotives.

The cars are designed as all steel motor coaches. They, of course, have the usual departure from steel construction in the headline, windows, arm rests and interior wainscotting. The motor coaches, already designed, are 65 ft. 6 in. overall dimension with approximately 57 ft. between body corner posts. All doors are swing doors thus permitting ample structural shapes to be used in designing for collision stresses. Reversible seats are located through most of the length of the coach with longitudinal seats at each end.

The cars are arranged for high level platforms at stations, or can be quickly changed to low level conditions. The vestibules are provided with diaphrams which protect from inclement weather when going from coach to coach in the train. Because of tunnel clearances the roof of these coaches will be a "turtle back" design.

The trucks are of the plate frame type, M. C. B. equalized with floating bolster of structural shapes. Both trucks per car are motor operated and are designed with clasp brake rigging. Solid rolled steel wheels are specified.

Current is collected from a pneumatically controlled pantograph. A system of contactor control provides the necessary combinations of circuits for the acceleration and running of the coach. These contactors are solenoid operated switches energized by contacts in the master controller located in the operator's cab. From any master controller in the train, all the motors in the train may be controlled. All motor coaches have double end equipment. In this cab are also located the other control apparatus and auxiliary switches.

The coach is lighted and the auxiliary circuits are fed by a motor-generator set having a 2400 volt motor and a 600 volt d.c. generator. This generator supplies the power for the motor driven air compressor. From taps brought out of the generator, to slip rings, current is collected for the headlights. A highly concentrated tungsten filament lamp of the new gas-filled type supplies the light. The heating of the cars is accomplished by air ducts through which is blown air from across a 2400 volt resistance type heater. The voltage required for the blower type motor is obtained by shunting that motor across sufficient resistance located as near the low potential end of the heater as is possible.

The motor equipment for driving the coaches consists of four 125 h.p. 1200/2400 volt commutating pole, fully ventilated motors. The motors on each truck are connected permanently in series with the fields of both motors connected directly to ground.

Gearing is accomplished through a motor pinion and rolled steel gears cut from a rolled blank. This motor equipment is capable of continuous suburban service when three motor coaches are coupled together and hauling two trail cars. The maximum trains for some time will thus comprise five cars.

The air brake equipment on the motor coaches is similar to that found upon all first class steam railway equipment with the addition of a motorman's control valve.

The locomotives are required to handle the steam trains incoming and outgoing from Montreal. These trains when approaching from the west will change power at Cartierville and proceed into the terminal with electric engines, and vice versa when leaving Montreal. The Quebec Junction engine will handle those trains going east. Two electric locomotives will handle the heavier Transcontinental trains up the 0.6 per cent. grade of the tunnel. The two locomotives will be handled by one engineman. All other trains will require but one locomotive.

The locomotives are of the box cab articulated truck design, weighing approximately 83 tons all on drivers. This design permits of a maximum adhesive weight at all times. The wheel arrangement is known as the 0440 type, meaning no guiding wheels, four wheels per driving truck and no trailing wheels.

Current is collected through two roller pantograph trolleys per locomotive and is brought to the motors through two contactor banks which provide the necessary resistance combinations for acceleration and running.

The operator's compartments in each end contain the usual complement of gauges, meters, controller, auxiliary circuit switches, brake valves and a 2400 volt resistance type radiating heater. Between the operator's compartments is located the control apparatus. Longitudinally are located the two contactor banks, back to back. Directly above in a totally enclosed compartment is located the resistance bank. The heat generated by the resistance grids will be conveyed through ventilators in the roof by air ventilation. At one end of the contactor bank is located the air compressor having a piston displacement of 100 cu. ft. air per minute. The compressor is driven by a 2400 volt motor having two windings and commutators in series. At the other end of the contactor bank is located a 2400 volt motor driving a 125 volt d.c. generator which supplies the auxiliary circuits of the control equipment with power. Direct connected to this set is a blower for ventilating the traction motors.

The trucks are of the rigid bolster type with the end frames and side frames of cast steel, side and cross equalization providing a very efficient suspension. An interesting detail of the drive from the motor is that a gear rim will be shrunk onto an extension of the wheel hub casting instead of a gear shrunk upon the axle. Because of the space required by the motors and the requirement of twin gear drive this method of gearing has been developed. The articulation between the trucks permits all of the buffing and pulling stresses to be transmitted through the trucks and thus relieves the cab structure.

The motor equipment consists of four 315 h.p. 1200-2400 volt motors. These motors are of the usual heavy traction type having twin gearing, box frame, commutating poles and forced ventilation. The motors are nose suspended. Two motors on each truck are connected in series in a permanent manner. These locomotives are geared with a minimum reduction in order to permit reasonable speeds without excessive armature peripheral velocities. This of course limits the tonnage behind the draw bar. About 600 ton trailing passenger trains and 1,000 ton freight trains will be the duty of these locomotives. Only a few freight movements per day will be required of these electric engines. However, at some future time the gearing on these locomotives may be changed to a greater reduction and they at once will handle heavy tonnage service. No other change will be required.

The all-rail return for the propulsion current has been chosen rather than install negative feeder copper. In rather complicated interlocking it may be necessary to run short lengths of cable, but proper return conductivity can be obtained elsewhere by bonding all rails and frequent cross-bonding. The lower amperage in the 2400 volt system assists in the prevention of rail drop. From the rails the return to the sub-station negative bus is made through cable on conduit.

Further Details

There remain three details of the electrification.—

For the maintenance of the electric rolling stock, there is being designed a shop at Cartierville. This shop will be equipped with the most up-to-date machine tool equipment consisting of such tools as boring mill wheel, turning lathe, wheel press, planer, shaper, forge shop and such sundry appliances. All of the renewal and repair work will be done here. It is planned to handle the locomotive work at one end and the motor coach work at the other end of a long building. The machine bay, located in the middle will thus divide the two classes of work. A 50-ton crane will serve the whole shop.

The stores department will occupy quarters nearby. No trolley power will be brought into the shop. All shifting will be accomplished by an engine or car. There will be provided "pit tracks" for the regular mileage inspection and for easy access to the underneath of the car. Power for the machine tools and lighting will be transmitted from the Terminal Sub-station to the shop as three-phase 11,000 volt power and there stepped down. This transmission line will run along cross arms located on the traction trolley bracket poles.

The electric zone is to be signalled according to the most up-to-date minute standards for safety. All electric interlocking plants are to be installed at the Terminal, Model City, Quebec Junction and Cartierville Yards. All of the high mast signals will be of the three position upper left hand quadrant type with bottom case mechanisms. All dwarfs and switch machines will be motor operated. Signal power will be transmitted at 2300 volts, three-phase, 60 cycles. Electric detector circuits together with approach and route locking are features to be installed.

The tunnel automatic signalling will be accomplished by lights. Both tubes will be signalled in both directions under the control of traffic levers located in the portal towers. The tunnel lighting in both tubes will be accomplished from mains running in the duct line located in the center wall. Both tubes will be lighted consuming about 75 kw. of 3-phase power. The lights will be spaced some 30 feet apart.

Montreal Tramways Recent Developments

The enormous growth of Montreal, particularly in the north and west, has, in the last few years, accentuated the transportation problem—always difficult to solve in cities with populations increasing at great rates. Montreal is peculiar in that it has no suburban railway service to speak of, and has to depend almost entirely upon its tramways for the carriage of passengers in the city and to and from the outlying districts. The consequence of this expansion of population was a congestion of traffic in the rush hours, especially in the central districts. As the population increased, the traffic of the tramways company naturally rose, and as an example of this, we may quote the passengers carried in 1910 with those of 1913. In the former year, when the company was known as the Montreal Street Railway Co., the number of passengers was 107,241,406; last year it was 213,397,325. It should be explained that the latter figures include the traffic of the Montreal Terminal Railway Company and Montreal Park and Island Railway, which with the Suburban Tramway and Power Company are absorbed by the Montreal Tramways Company. But even allowing for this, the increase has been very large. The track mileage in 1892 was 12½ miles; in 1910 it was 144¼ and it is now, for the combined system, 247.

The problem of the congested traffic naturally called for a prompt solution. Negotiations between the company and the city were carried on, and the city agreed to concede new routes and also the re-routing of other lines. The company on its part decided on a very extensive programme of improvements, which is still in progress. With such a very wide area ever increasing in population, the execution of improvements takes a considerable time, but it may be fairly said that the expenditure up to date has resulted in a material amelioration of the congestion. In two years the company have spent over four million dollars on betterments.

In addition to putting on more cars, the company decided to improve the physical condition of the track. Up to the present about 28 miles have been constructed or rebuilt, a portion of work in the former class being due to the new routes and re-routing referred to. The chief problem was to prevent the heaving of the pavement due to frost, which necessitated heavy expenditure on maintenance. The experience of the past winter shows that the new system adopted is successful, and that frost now plays practically no part in the heaving of pavement. The great point in this prevention was the insertion of tile drains beneath the track, allowing the water to flow into the manholes, and thus removing the cause of the destruction of the track.

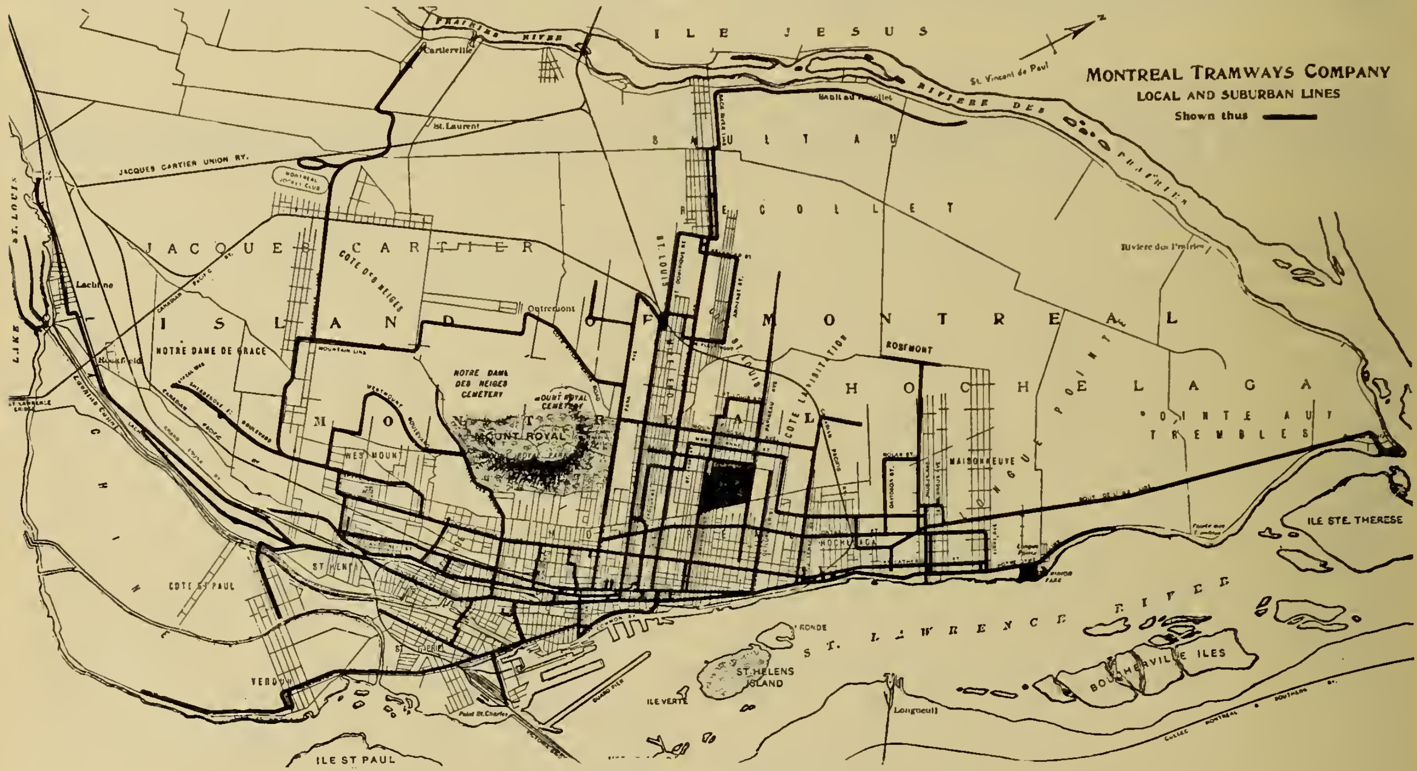
Under the plans adopted, concrete under the ties in making the pavements was abolished, rolled stone being substituted. In many instances the 87-lb. rails were replaced by 115-lb. grooved rails of a special rolling, and in future this description only will be used. Many new intersections were put in, with clearance curves to enable the cars to turn the corners without interfering with cars coming in other di-

The two-car train used by the Montreal Tramways Company.

rections. While on this subject, it may be mentioned that originally the rear platforms of the cars were nine feet long; these have been reduced by two feet, giving altogether an increased corner capacity of 70 per cent.

Flat tie rods in place of round tie were adopted, thus obtaining a better joint in the paving. A roller rail bender, electrically driven, was recently installed; compromise rail joints were eliminated, and by the use of the thermit weld an almost perfect joint secured. Another improvement was accomplished by the installation of a machine to mechanically offset joints. By these and other means the system has been standardized, this including the rails, spikes, ties, etc. The whole system of track construction was thoroughly studied before the improvements were decided on, with the object of adopting the very best system of modern practice, so that the road-bed would be of a more permanent character and maintenance charges reduced.

The system is now divided into ten sections, with a foreman and gang to each section, which varies from 10 to 30 miles, according to the nature of the traffic. The foremen and men are responsible for the physical condition of their section, and they report periodically on all matters relating to the trackage, repairs, material, etc. This enables the chief engineer to keep an eye on maintenance charges, and also to accurately gauge the cost from week to week.



Map of Montreal Tramways System.

The new rolling stock is of an exceptionally fine type About 325 new cars of what is now the standard type have recently been put into service, and in addition 25 two-car units, the latter being on the St. Catherine Street route throughout the day. The colors of the cars are now standardized light olive green for the bodies of the city vehicles, with the windows in cream; light orange for the bodies of suburban cars with the windows also in cream. Several improvements have been embodied in the design of the new cars. Thus, the front doors are now under the control of the motorman; they cannot be opened from the outside, and the motormen have the strictest orders not to open them until the car stops. This is to prevent accidents from passengers alighting while the car is in motion. All the latest type of cars are fitted with wooden shearing blocks placed right behind the main bumper for the purpose of absorbing shocks. In steel cars the slightest shock is apt to start the rivets, but the wooden block absorbs the shock to a very large extent. It is also proposed to install coasting recorders, to register the amount of free running.

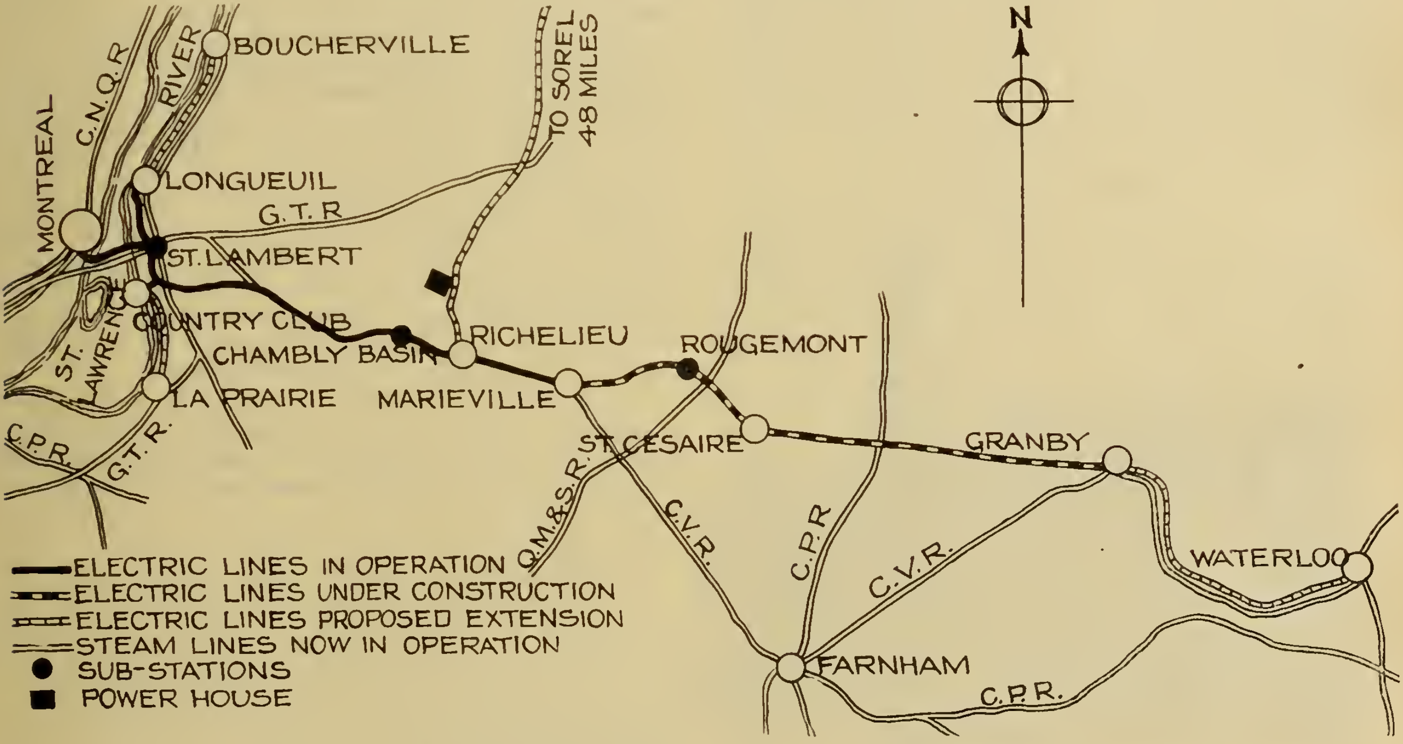
The trailers or two-car units—of which we have already given some particulars—have more than satisfied the management. They are spacious, comfortable, and run with great smoothness. The general arrangements make for economy of time and also for safety. The steps and doors are under the control of the motorman and conductors, and there is no possibility of a passenger getting in or out while the car is in motion. When all the doors are closed, an electric light is automatically turned on in front of the motorman, giving the signal to start. The bell signal is eliminated on these cars except in the case of emergency. An emergency door fitted in the rear of the trailer, is operated by means of a tripping lever. Should the cars get separated a semi-automatic service comes at once into operation and the brakes are immediately applied. These cars as well as those of standard type are ventilated by an exhaust system, while in the winter the air comes in under the seats and passing under the heater is immediately warmed. All cars are now fitted with seats for conductors and motormen.

One of the most recent developments in connection with the prevention of accidents is the inauguration of a Safety First campaign. This was not confined to the employees, as the company desired the co-operation of the general public, and particularly of the owners of motors and other vehicles. The urgency of taking every precaution was impressed on the men by heart to heart talks, which have proved the most effective method of securing compliance with the instructions of the management. The company have gone beyond the mere talking stage—they have adopted in their latest rolling stock mechanical devices calculated to prevent accidents, and these, added to the precautions taken by the employees and others have materially reduced casualties of every class. The Safety First movement, while of value to the company from the purely economic standpoint, is of equal importance to passengers and pedestrians, as it results in lessening accidents, often due to carelessness on the part of the public.

The Montreal and Southern Counties Ry.

Up to the end of 1909 the facilities for reaching the southern shore of the St. Lawrence were very meagre, and naturally there were comparatively few people resident in the towns immediately opposite Montreal. In November of that year the Montreal and Southern Counties Railway started operations, and since then there has been a gradual expansion of its system. The result has been a steady growth in the population of the south shore, and the opening up of districts which were hitherto of a purely agricultural character. Several important industries have located at favourable points, and when Harbour Commissioners have completed their improvements, it is more than probable that there will be an addition to the plants.

The plans of the company contemplate offering facilities within a radius of 75 miles from Montreal; a large part of that programme has already been carried out, under the direction of Mr. Bion J. Arnold, of Chicago; the contract for the latest extension being from St. Cesaire to Granby, P.Q. The line starts from McGill and Youville streets, Montreal, crosses the St. Lawrence and at St. Lambert divides—one short section going to Longueuil, and the other to Richelieu, Rougemont, and St. Cesaire in which direction all the extensions have been constructed. From Greenfield Park, just beyond St. Lambert, the line reaches Richelieu by the Central Vermont's right-of-way, which has been electrified. At Richelieu the line crosses the Richelieu River, and beyond this point through Marieville to St. Cesaire the Central Vermont's right-of-way has also been electrified. When the line to Granby is finished fifty miles will be in operation. Other projected extensions are from Longueuil to Boucherville, a distance of 5 miles; from the Country Club to Laprairie, 4 miles; and from Richelieu to Sorel, about 48 miles.



Map showing present and prospective lines of M. & S. C. Railway Co.

Sub-stations have been erected at St. Lambert, Chambly and Rougemont, and another one will be built just outside Granby. Power is supplied from the hydro-electric power station at Chambly Canton belonging to the Montreal Light, Heat and Power Company. The sub-stations have concrete foundations, floors, sills, coping and roofs, supported on steel I-beams, C. I. columns, and brick walls.

The car barns are at St. Lambert; the original structure has a capacity of nine 50 ft. cars and a new one with four entering tracks, a capacity of 16 cars; there are also inspection and repair pits in both barns. Adjacent to the new building are the superintendent's office, despatchers' headquarters, locker rooms, and store houses.

The current from the Montreal Light, Heat and Power Company's power station is 3-phase, 63 cycle, 25,000 volt., and is carried into Montreal, there being a pole line on each side of the track along the Central Vermont Railway. At St. Lambert and Chambly the current is tapped in duplicate and transformed in the Montreal and Southern Counties sub-station at Chambly to 2300 volt and then converted into 600 volts direct current by motor generator set, while at St. Lambert it is changed by rotary converters. This is distributed to the trolley wires over bare aluminium feeder cables.

On the latest extensions, the catenary type of overhead construction has been employed. The standard type is used, consisting of 7/16 in. Siemens Martin grade 7 strand galvanized steel messenger cable, from which is hung on tangents at intervals of approximately 13 feet 8½ in., No. 4/0 B & S gauge American standard hard grooved hard drawn copper trolley wire, supplied by the Eugene Phillips Electrical Works, Limited, the Northern Electric Company and the Canada Wire and Cable Company. The hangers are of the floating type, specially designed to neutralize the shocks in transit. Cedar poles are used, spaced 110 and 150 feet on tangents and 90 to 100 feet on curves. Messenger wire is supported on porcelain insulators which are fastened to 10 ft. T iron brackets attached to the poles. With few exceptions the bracket type of construction is used. However, where the curvature or special conditions will not permit, the messenger wire is supported by cross spans, using 3/8 in. 7-stranded steel cable and pole type porcelain strain insulators. The catenary hangers and miscellaneous material were supplied by the Ohio Brass Company. Along the entire length, the trolley wire is supplemented by bare aluminium feeder with a conductivity equal to 500,000 c.m. copper cable. Part of the feeder cables are supported on malleable iron composition type of insulators of Electric Service Supply Company make and the rest of cables on glass cable insulators carried on standard oak pins, which in turn are supported by 3¼ x 4 in. x 4 ft. pine cross arms attached to the poles with galvanized braces. On the curves the cross arms are double and iron posts are used instead of oak.

The trolley is sectionalized in front of the sub-station and midway between them the section breakers being bridged by disconnecting switches attached to the feeder. During normal operations the sub-stations run parallel. Garton Daniel 625 volt lightning arresters are placed on every tenth pole, and connected to the feeder taps on these poles. The Northern Electric Company has installed a telephone despatching system of the selector type of ringing equipment. The line is No. 10 hard drawn copper wire supported on pony glass insulators on side brackets directly attached to the poles supporting the trolley. The telephone wires are transposed at intervals of three poles to overcome the induction from adjacent high tension lines.

Future Extensions

Both in the overhead construction and sub-stations, the work has been laid out to permit of future extensions. At Chambly a 600 h.p., 3-phase, 63 cycle, 2300 volt, 10 pole wire-wound rotor induction motor, made by the Canadian Westinghouse Company, has been installed. This is direct connected to a 400 kw., 600 volt compound wound direct current interpole Westinghouse generator, power being supplied by three 185 kv.a. delta connected oil-insulated self-cooled transformers, high tension 24,000 volt, low tension 2300 volt. The Northern Electric Company supplied the other equipment at Chambly, including the a.c. and d.c. switchboards and line apparatus, Northern type A disconnecting switches and air-cooled choke coils, both 100 amp., 25000 volt, the twenty 5-amp. Wagner o.w.g. 40 current transformers, lightning arresters and the 100 amp. 22000 volt, 3-phase circuit breakers. At St. Lambert there are three Canadian Westinghouse rotary converters each of 500 kw. capacity, 6-phase, 600 volt, d.c., 63 cycles at 945 r.p.m., 8-pole, compound wound, self-starting on the a.c. side from low voltage taps from transformers, and built with shaft extensions to take starting induction motors if needed in the future. Connected with each unit are three delta connected 185 kw 24000/428 volt, 63 cycle Westinghouse transformers of the same type as at Chambly; the equipment, duplicating that at Chambly, was also supplied by the Northern Electric Company. From the a.c. line switches run bare copper bus bars. From each transformer to a starting panel run two 600,000 c.m. main leads and two 300,000 c.m. rubber covered double braided starting taps; while from the a.c. starting panel six 600,000 c.m. rubber and lead covered leads are led through three ducts to the machine. There are similar connections for the positive and negative and equalizer generator leads to the d.c. switchboard. Positive feeder cables from the switch on the d.c. board to the outside of the building are 600,000 c.m., r.c.d.b., two cables to each feeder panel.

At Rougemont sub-station a 450 h.p., 3-phase, 63 cycle, 2300 volt, 10-pole wire-wound rotary induction motor direct connected to a 300 kw., 600 volt, compound-wound direct current interpole generator supplied by the Canadian General Electric Company is installed. The transformers are the Canadian General Electric type H, 63 cycle, 150 kv.a., 25,000 volt, with 2300 volt taps on the secondary side. The switchboards, both a.c. and d.c., were furnished by the same company. All wiring in this station is of the open type, No. 1 bare hard drawn copper wire, being used for all inside high tension wiring. All disconnecting switches, oil switches, current transformers, lightning arresters and equipment for the switchboard were supplied by the Canadian General Electric Company.

Rolling Stock

Owing to the loading of the Victoria Bridge, the weight of the rolling stock is limited to 65,000 lbs. each car. The cars originally put into service included 14 single end control, 49 ft. 4 in. by 8 ft. 1 in. cars, with 56 seat standard interurban closed bodies. The motor equipment of each consisted of four Westinghouse 40 h.p., 600 volt, d.c. motors. The trucks are of the standard Curtis type, placed 25 ft. 4 in. centre to centre, 6 ft. wheel base. Westinghouse automatic air brakes with individual compressors and the usual hand brakes are on each motor. Later eight cars built by the Ottawa Car Company were put on to the service. These cars have 50 h.p. at 500 volt d.c. interpole motors. There is seating accommodation for 56 people. Two of the cars have baggage compartments, two are straight passenger, and four are combination smoking and passenger. The Westinghouse type H L multiple unit control system is used, the cars being fitted with Tomlinson automatic couplers. Crouse Hinds luminous arc headlights are used. The car heating system consists of Gold 115E1 heaters in two circuits of 6 and 12 each. Recently ten new cars were received from the National Steel Car Company, of Hamilton. These are 54 ft. 2 in. long with through platforms, and are equipped with water coolers and toilets. The electrical equipment consists of four 50 h.p. interpole induction motors supplied by the Canadian Westinghouse Company, while the brake equipment is of standard Westinghouse automatic design and control is H L, supplied by the same company.

On the Central Vermont tracks the St. Cesaire cars are operated according to standard steam road rules, the despatching of the train being done by telegraph from the office in St. Albans, Vt. The double despatching arrangement permits of the simultaneous operation of the electrical and steam road traffic.

The grades of the road are light, averaging 0.305 per cent., not taking into account the 3½ per cent. at the 550 foot approach to the Victoria Bridge. Near the Country Club where the line crosses the Grand Trunk main line, a special interlocking plant has been installed by the General Railway Signal Company of Canada. The apparatus is housed in a two-storey building. Another crossing of the Grand Trunk tracks at Riverside, near the Victoria Bridge, is controlled by a plant which is only interlocking for the electric line.

On the 8½ miles of track first constructed 80 lb. rails on oak ties are used; while on the extension 60 lb. A.S.C.E. section Dominion rails and splice angle bars were used. Pennsylvania splice bars style D1 were put in on the old 56 ft. rails of the Central Vermont Railway. The track return circuit is connected to the negative bus bars at the switchboards of the sub-stations, while the lightning arresters are grounded at the sub-station in a four foot square tinned copper plate, buried in permanently moist earth, with two foot of crushed charcoal above and below.

The Kirkfield Portland Cement Company have a hydro-electric plant operating on the Gull River at Elliott's Falls near Norland P.O. The head of water is 21 feet. Two Jenckes turbines, 500 h.p. each are direct connected to Canadian General Electric a.c. generators, 500 volts, 3-phase, 25-cycle, 350 amperes. Current is stepped up to 15,000 volts for transmission to the company's works at Raven Lake 16 miles distant. The electrical equipment also includes one exciter unit consisting of turbine and 200 ampere, 125 volt d.c. generator.

Northern Electric's New Wire and Cable Plant

The new wire and cable plant of the Northern Electric Company, Limited, now nearing completion, occupies an area of 178,000 sq. ft. (over four acres) bounded by St. Patrick, Shearer and Richardson streets in the city of Montreal. The present plant, located at the corner of Guy and St. James streets, being entirely inadequate to cope with the increasing demand for the wire and cable products of this company, has necessitated the erection of an enormous new structure which when completed will be the largest single plant in America for the exclusive manufacture of wires and cables.

E. G. M. Cape & Company, Limited, have the general contract for the building. The foundations for walls and columns are composed of plain and reinforced concrete. In the main building and some of the one-storey portions, the columns rest on Raymond concrete piles, of which 4,,000 have been driven with an average length of 12 ft. On each group of piles rests a reinforced concrete cap on which bases for the building columns are placed.

The 6,500 tons of structural steel required for the superstructure were supplied and erected by the Dominion Bridge Company. Bethlehem H columns, girders and beams were used almost exclusively throughout.

The most modern fireproof construction has been specified throughout the entire building, all interior columns being incased in 4¾ inches of hollow terra cotta and beams in 2⅜ inches. The floors are composed of hollow terra cotta segmental arches with a span of 6 ft. 8 in., and are suitable for a live load of 288 lbs. on the second to seventh floors and 150 lbs. on the eighth floors.

A stone concrete fill is poured over the arches, in which wooden sleepers are embedded, and the underflooring is nailed to these sleepers, and over this, the final maple flooring is laid at right angles. The National Fireproofing Company supplied all the fireproofing terra cotta, amounting to 11,000 tons.

The walls are built of Laprairie plastic brick, seven millions being used. All the lintels in the courts and on the street sides, together with the architectural ornaments and copings on the street sides were supplied by the Atlantic Terra Cotta Company, of Tottenville.

The main buildings, shaped like the letter "E," have two main courts, which serve to provide ample lighting facilities for the 500,000 sq. ft. (over 12 acres) of floor space from the interior as well as the exposed sides on the streets. These courts have sloping roofs of book tile with large skylights. The G. T. R. and C. P. R. railway tracks run into one court which has large platforms for shipping and receiving purposes. Each track is provided with a 150-ton Canadian Fairbanks track scale.

There are four travelling electric cranes, one 50-ton, one 20-ton, one 20-ton with 5-ton auxiliary hoist and one 10-ton, all made by the Case Crane Company. The 50-ton crane will be used for handling reels of armored cable, the 20-ton for the lead covering department, the 20-ton with 5-ton auxiliary for the turbine room, and the 10-ton for the impregnating tank room. The two 20-ton cranes are arranged so that they can pass material to the 50-ton, which will convey it over the railway tracks or vice versa.

Fire walls with automatic steel fire doors on both sides, divide the building into various sections. Each section has a fire and smoke-proof stair tower with iron stairs at both ends, thus providing ample and safe means of exit in case of fire on any floor. The fire doors for the whole building were supplied by the Architectural Bronze & Iron Works and the iron stairs by John Watson & Son, Limited. All windows throughout the building have steel frames with wire glass. Pivoted sections of these windows can be opened with operating chains equipped with fusible links, thus making them self-closing in case of fire. The 95,000 sq. ft. of steel sash required for the factory was supplied by the Trussed Concrete Steel Company and the casement sash for the offices by Henry Hope & Sons, Limited.

All drains and underground sprinkler mains are being installed by James Ballantyne. The sprinkler and fire hose systems above the first floor level are supplied by H. G. Vogel Company (Canada) Limited, and consist of 6,000 sprinkler heads and fire hose located at convenient points in the building. These systems are supplied with water from the city mains, steamer connections on the street and a 1,500 gallon Worthington Underwriters' fire pump which is connected to a 100,000 gallon concrete reservoir and the canal.

Five 6,000 and one 15,000 lb. freight elevator with a travel of 100 ft. and 25 ft. per minute respectively, will be used to handle the transfer of material for manufacturing, and two high speed passenger elevators travelling at 350 ft. per minute, will be used to serve the general offices of the company which are situated on the eighth floor of the building. They are being supplied by the Otis-Fensom Elevator Company. This floor has no columns, the roof being supported by steel trusses with large skylights. The absence of columns afford splendid facilities for the laying out of offices to suit the requirements.

Boiler and Power House—Northern Electric Co.

A unique point in the design of the building is the storage space secured on the roof of one section by means of paving bricks. This roof is served by means of one of the 6,000 lb. freight elevators.

Large intake pipes from the canal supply the reservoir and the water used for condensing purposes. An automobile garage and a wagon court with platforms facing St. Patrick street are so arranged that the material can be readily loaded for city delivery without having to cross the railroad tracks.

The building will be heated by a forced circulation hot water heating system. Exhaust steam from one of the main turbines will be passed through closed heaters. The water will be circulated by means of a 4,000 gallon Alberger single stage volute pump directly connected to a Alberger Curtis steam turbine. The vapors and condensate from the exhaust steam will be carried from the heaters by means of an

Steel construction work--New plant of Northern Electric Company, Limited

Edwards air pump with a tail pump. This makes a very flexible system to suit the changes in the outside temperature, as the vacuum can be increased in warm weather, thereby creating a lower temperature of the exhaust steam and decreasing the amount of steam required by the turbine as the vacuum increases. In extreme cold weather the turbine can exhaust into the heater at atmospheric pressure and thus increase the quantity and temperature of the steam. When running two turbo-generator units in parallel, one turbine can run condensing, while the other exhausts into the heating system and its load can be varied to suit the amount of steam required for heating purposes. The power plant equipment for this heating system is in duplicate, either one of the units being large enough to take care of the whole system. The enclosed heaters mentioned above were built by John McDougall Caledonian Iron Works, Limited.

The water required for the house service system and for manufacturing purposes will be pumped from the 42-in. intake pipe mentioned above by means of Deane motor driven single acting helical geared triplex pumps, also supplied by John McDougall Caledonian Iron Works Company. The Canadian Ingersoll Rand are supplying two steam driven air compressors, which have a combined capacity of 1200 cu. ft. per minute.

The Power Plant

The power plant is of the most modern design. Coal can be stored in large quantities and will be transferred to the storage bins over the front of the boiler by means of a Telpher car and clam shell bucket. Ash handling equipment takes the ashes directly from ash shutes under the boilers and delivers them into ash storage bins which in turn deliver them into railroad cars or carts for disposal. Ashes can also be handled by means of small cars on an industrial railway running in the basement of the boiler room. The Telpher car will raise the body of each of these cars off the truck, through a hatchway in the main boiler room floor, and will carry them over to the ash storage bin. This method of ash handling will only be used when it is necessary to overhaul and repair the regular ash handling equipment.

A 225-foot chimney built by the Alphons Chimney Construction Company, serves four B. & W. boilers nominally rated at 650 horse power, but which will be forced to deliver 1,000 horse power when necessary. These boilers are fitted with B. & W. chain grate stokers and superheaters. The exhaust steam and condensate from the heaters, turbines, condensers, and steam-driven auxiliaries is brought to a Warren and Webster feed water heater, which is capable of raising 107,000 lbs. of water per hour to 210 deg. From this heater the water is returned to the boilers by means of two Weir boiler feed pumps, each with a capacity of 6,000 Imperial gallons per hour. General Electric Curtis horizontal turbines form the motive power for the generators and are placed on structural steel stands directly over the Alberger condensers, thus insuring a high vacuum. The condensers are located over two 42-in. pipes leading to the canal. From one of these pipes the water is drawn by a turbo-volute turbine-driven pump, and after having passed through the condenser is discharged into the other pipe. Tunnels leading from the turbine and pump room are used to run the power and lighting circuits, the flow and return pipes of the forced hot water heating system, the house service water lines and the high pressure steam lines for manufacturing purposes.

The turbine room has been laid out for two 2,000 kw., and two 1,000 kw., turbo-generators, two 460 kw. rotary convertors, and two 75 kw. turbo-driven exciters. One 1,000 kw. and one 2,000 kw. turbo-generators and two rotary convertors will be installed now. The generators are 3-phase, 60 cycles, 440 volt, star wound with neutral connection brought out to the switchboard. The exciters are 125 volts and generator voltage will be controlled by Tirrill regulator.

General view of Northern Electric plant.

Air for the ventilation of the generators will be taken from a duct in the foundations of the generators and forced through the windings and air passages by fans integral with rotors. Screens will be provided in the pent house of this duct, to exclude dust, etc.

The horse power of connected load will be approximately 550 h.p., direct current at 115 volts and 4,000 h.p. alternating current at 440 volts. For the supply of the former two 460 kv.a. rotary converters, with necessary transformers and starting switches, will be installed, the neutral being brought out from each transformer bank for the neutral of a 115/230 volt 3-wire direct current system.

The switchboard for the control and distribution of this power will consist of a main board of twenty-five Blue Vermont marble panels on the turbine room floor. On this board will be mounted the meters for measurements of outputs of generators and loads on the feeders, also the direct current bus-bars both for exciters and direct current factory load, and control equipment for twenty-five solenoid operated feeder switches for alternating current distribution. These switches will be mounted on Monson slate panels on a mezzanine floor under the turbine room floor. The alternating current 440 volt bus-bars and generator switches will also be located here.

Generator switches will be non-automatic with bell ringing attachment and feeder switches automatic, as mentioned above. All feeders will leave the turbine room in a tunnel from which they will branch off to the various buildings in three inch fibre conduits. These fibre conduits will lead to cable pits from which risers of three-inch conduit will be carried to distributing panels. All alternating current cables will be three conductor paper insulated, leaded; direct current cables being single conductor leaded. For lighting factory area, four-light clusters, wired series parallel, will be used. As mentioned above, the neutral point of generator windings will be brought out. The lead sheath of the lighting feeder cables will be bonded to the neutral bus and lighting circuits will connect one wire to one of the three conductors, the other to the sheath giving approximately 266 volts across two lamps in series. Lighting feeder cables will lead to distributing boxes on the third floor of each section from which circuits will run to the panel boxes on the different floors. Power feeders will run to distributing boxes on the third and fifth floors from which circuits will run to power loops on each floor.

All wiring except that in general offices will be open conduit. The general offices will have outlets for fans, dictographs, annunciators and telephones, all wiring concealed in conduit.

A large number of 3-phase, 60 cycle motors will be used for direct connected, belt and group drives.

L. K. Comstock & Company have the contract for wiring the lighting and power circuits.

An artesian well is being drilled by Wallace Bell Company, Limited, and will be used for drinking water and for manufacturing purposes.

In addition to the fibre protection system, a regular watchman's service system will be installed so that the building will be patrolled at all times outside of the regular working hours.

For the convenience of watchmen and to avoid the use of oil lanterns in the plant, a certain number of electric lights will be kept burning all night to form a pilot system so that in cases of emergency the workmen in the building can easily locate the fire apparatus and also the exits.

The following features in connection with the building are of interest:—The total excavation amounts to some 50,000 cu. yds. Over 14,000 cu. yds. of concrete have been used for foundations. 1,500 carloads of building material have been received up to the present time. 100,000 sq. ft. of glazing has been used and approximately 100,000 sq. ft. of hot water radiation service will be required.

The work has been carried on under the direct supervision of Mr. E. F. Sise, President of the Northern Electric Company, Limited; Mr. J. D. Hathaway, General Superintendent; Mr. J. S. Cameron, Plant Engineer, and Mr. W. J. Carmichael, Architect.

Personals

Mr. D. W. Houston for some time acting superintendent of the municipal street railway department of the city of Regina has been appointed superintendent.

Mr. T. R. Fulton has resigned his position as local manager of the Toronto office of the Eugene F. Phillips Electrical Works. The office will be temporarily in charge of Mr. G. R. Blair, Mr. Fulton's assistant.

Mr. H. H. Scott the newly elected president of the National Electric Light Association is a Canadian, born in Orillia, Ont., September 14, 1874. Mr. Scott is general manager of the Doherty Operating Company which operates 104 public utility plants in various parts of the United States. He is also a director in a number of the corporations owned and controlled by Henry L. Doherty & Company.

Mr. Guilford M. Stuart.

Mr. Guilford M. Stuart, president of Stuart-Howland Company, has been elected president of the Canadian Club of Boston, an evidence that while for business reasons he is a citizen of the United States he is still heartily interested in and thoroughly in touch with the land of his birth. Mr. Stuart was born and spent his early life on a farm near Albert, N.B., and received his education at the public schools in that section. In his early twenties deciding to leave the farm he graduated from the St. John Business College and entered the employ of R. P. McGivern of that city as bookkeeper and confidential clerk. After five years he removed to Boston and started in on his own account to market woodworking machinery. In this connection he travelled the eastern half of the United States for five years and later for three years in Europe, returning to Boston in 1898 where he entered the electrical supply business as treasurer of the Anchor Electric Company. In 1900, with Chas. F. Howland and Arthur Howland he formed the Stuart-Howland Company, of Boston, taking the offices of treasurer and general manager. Later Mr. Stuart acquired the interests of the Howlands and is now president, treasurer and practically sole owner of this company which, owing to the energy and business acumen displayed by its manager throughout is now one of the best and most active electrical supply jobbing houses in the United States. Mr. Stuart is also treasurer and practically sole owner of the Standard Magnet Wire Company, of Boston. If he displays as much energy in the affairs of the Canadian Club as he has done in his private business enterprise a marked growth in the membership, activity and usefulness of this club may be expected.

A Bright Outlook

At this time of business depression it is well to note figures just issued by the Statistical Department of the Dominion Government which state that Canada's total land area is 1,401,316,415 acres, of which only 7.18 per cent. or 109,770,085 acres are occupied as farm lands. The extent of good farm property is given as 440,951,000 acres so that our grain products, immense as they are already, are less than a quarter of what we are capable of producing.

Ground was broken for a new factory for the Holtzer-Cabot Electric Company on Amory Street, Roxbury, Mass., on May 21.

Electrical Engineering in the Industrial Field

The Engineer in Relation to Client, Contractor and Architect

By F. R. Ewart

The time is arriving in Canada for more systematic application of engineering methods to electrical work in the industrial and commercial field. The amount being spent annually on interior installations is increasing rapidly. More and more establishments are relying on electricity for light and power. More complete and costly systems are everywhere being installed. Expert handling of such work, therefore, is becoming a necessity for the benefit of each business in particular and for the economic good of the country as a whole.

In the past, the business man has had nobody to turn to for help in such matters. In many cases he has had to ask some contractor "How much to wire my building?" If the sum named has sounded reasonable, he has given orders to proceed. Since neither party to the agreement has any very definite idea of the requirements, it is not remarkable that the result is often very unsatisfactory. The contractor is probably doing his honest best, but cannot, for many reasons, plan everything carefully before starting the work. This same method might have worked out all right twenty years ago, when the installation was rudimentary and the cost trifling. Under modern conditions the work is frequently complex and the cost considerable. The same business man would not ask a building contractor "How much to build me a factory?" He would employ an architect to draw plans and specifications for his building and see that these were satisfactory before starting any work at all. In other words, he would be anxious to know what he was getting before going ahead. Why should he not exercise the same caution in regard to his electrical installation? It is true that the latter does not involve so much money as the building, but poor or ineffective work may prove as great a handicap in the conduct of his business in one case as in the other. The Pilgrim Fathers, no doubt, got on fairly well without the aid of the architect, but it did not take long for the development of the country to create a demand for his services. Today he is considered necessary for the erection of anything more pretentious than a wood-shed. Should the business man, then, content himself with the crude methods of the pioneer days of electrical work?

The Engineer and the Business Man

Until recently, the electrical engineer of this country has paid little attention to the business man's need of him. He has considered his only sphere of activity to be in the handling of large projects such as power developments, central station work or the manufacture of electrical apparatus. As the engineer has not offered himself to the business man, the latter has not been able to call on him. Some of the best engineers in the United States find a good part of their practice with business concerns. The time should, then, be ripe for the Canadian electrical engineer to advance his practice more definitely into the industrial field. It is the chief object of this article to roughly outline the nature of the practice of industrial electrical engineering on a consulting basis and also to show some aspects of the relationships between engineer, client, contractor and architect.

Let us suppose that a manufacturer engages the engineer to handle the complete electrical installation in a new factory. The engineer is given a set of building plans and immediately wants accurate information regarding what machines, equipment, etc., are going into the building and just where each thing is to be located. In a few rare cases the client has given this question close study and can supply the information. In most cases, however, he fails to see that this has anything to do with the engineer's work and asks him to go ahead and let the lay-out problem take care of itself afterwards. Right there the engineer must carefully explain that he is not proposing to scatter so many lights and power mains through the building and trust to Providence that they may meet the requirements. He shows, for example, how different kinds of work need different lighting and in general that every little detail of the electrical equipment should have an exact relation to the duty to be performed. Very often the question can only be solved by the engineer making up complete equipment layout plans as the first essential, before approaching his work proper. On this account he must frequently become an efficiency engineer and study the factory process of his client. He must lay out the whole factory from the standpoint of space, economy and efficiency of operation and produce a result that will satisy the manufacturer.

Illumination Not Guess Work

With this done, the engineer may next proceed with his scheme of illumination. This is not a matter of guess work. Each process or machine may have to be separately treated, and the best method of obtaining the necessary results determined scientifically. When he is through he knows exactly why he located each outlet where he did, just what equipment he intends using on each outlet, and just what results will be obtained in every case. It is no longer a question of experimenting with various equipments under various conditions to find anything that will be at all passable.

The next step is to connect up these outlets in proper circuit groups and feed these circuits from suitable distribution points. In this regard proper attention must be given to economy of materials, adjustment of capacity and provision of suitable control. Proper feeders must then be provided to supply these various points. It will be noted that the sequence is in opposite order to the flow of power, that is, beginning at the various machines, etc., and working steadily back to the power source. So often a mistake is made by starting with the service and feeders before determining the requirements they must meet. While a lay-out determined by the method described above is intended to fill exact requirements in an exact way, it will frequently be found that many features can be so planned so as to provide a reasonable adaptability in case of changing conditions in the future.

When all the work described above has been worked up into a complete plan, it is time to write specifications. The plan will indicate clearly the nature and location of everything, but cannot show in detail the exact nature and quality of each item. It should be the main purpose of the specifications to supplement the plan in this regard. The chief purpose of specifications is to cover thoroughly the sizes and qualities of the various materials to be used. Any special points regarding the manner of installing these materials should then be covered. So often specifications are found to consist largely of rules for the way in which various standard materials are to be made. Frequently these are nothing more than quotations from the N. E. Code or standard manufacturers' specifications. If the requirement is laid down, that all work must comply with the Underwriters' rules, it will not be necessary to describe how a steel box shall be built or how the insulation of a standard cable shall be made up. The engineer can confine himself entirely to the sizes, capacities and grades and in so doing will make his specifications much more explicit.

When plans and specifications are completed, a contract can be let and the work started. From then on, the engineer will have to regularly supervise the work as it proceeds. He will see that the work is done in strict accordance with his plans and specifications. He will also have to decide many minor details which could not have been originally foreseen. He may have to revise some feature due to changes in the architect's plans or needs of the client. Under such circumstances he will make the necessary adjustment with the contractor for extras or deductions, sometimes a delicate matter.

Purchase of Equipment

At the same time that the contract work is proceeding, he may also assume other important duties on behalf of the client. Probably the most important of these is the choice and purchase of equipment such as motors, elevators, etc. He must give careful consideration to the requirements, particularly in regard to capacities and mode of operation. This will often involve the "Safety First" problem, which is becoming so vital with the adoption of a Workman's Compensation Act. When he has decided what is required and proceeds to purchase he will be guided by two considerations,—quality and price. He will not necessarily buy the very best, no matter how high the price. Neither will he buy the cheapest regardless of how poor the quality. He wants a product that he can feel sure will thoroughly meet the requirements, and then he wants that product at the closest price he can get. Since the engineer is regularly in the market and is a good judge of values, he should be able to buy closer than the casual purchaser and in most cases he does.

While there are many other minor activities involved in the engineer's work, the foregoing should prove sufficient to give an insight into engineering practice applied in this direction. The natural question arises, "How does such work affect those most concerned, the client, the contractor and the architect?" "What is the relation of the engineer to these interests?" The client may realize some very strong advantages in the employment of the engineer. The time of the president or manager of a large concern is naturally valuable. The amount of time he will spend in working out the details of a more or less unfamiliar problem may be worth many times the engineer's fees. He can save himself a large part of the worry, which has a baneful influence in the upsetting of his regular work. In most cases he will make a good monetary saving, since the engineer will protect him from unnecessary expenditures and procure the real essentials at minimum cost. Best of all he will have in the end an installation thoroughly suited to his work.

All the dealings between engineer and client must be in the open. To get the best results, the client must take the engineer into his confidence, show him his factory methods clearly and give him a real insight into the workings of his particular business. The engineer, on the other hand, must keep the client advised of what he is doing and his reasons for doing so. He cannot afford, for instance, to accept commissions from dealers or manufacturers, unless the client agrees and the amount is credited towards the fees. In matter of this nature there is no better guide than the Code of Ethics of the A. I. E. E. The engineer will often find, too, that it is a difficult matter to convince the client of the correctness of his methods along some lines. In such cases, he must fight hard to win his point. If the work is not of the best in the end the fact that he has been over-ruled in many points will help the engineer's reputation very little. The responsibility is his, and the task of convincing his client is part of it.

The contractor may benefit quite as much as the client from the work of the engineer. In the first place, it insures fairness of competition. In tendering he knows that he is figuring on a clear-cut proposition and that every competitor will be compelled to figure on the same thing. As the requirements are laid clearly before him, he spends much less time in making up his bid than if he were uncertain on many points. The loss then in case of failure to obtain the contract is reduced to a minimum. He is also spared the necessity of doing a lot of gratis work. So often a contractor is forced to make plans and specifications of his own in order to show what he is tendering on. The expense of this is unwarranted even when successful and when he fails to land the business it means a bad loss. It also means that he is frequently shouldering the responsibility for details that should not properly be his.

The successful contractor can handle the work to much better effect than in the ordinary case. Losses of time due to uncertainty will be negligible. As the work is started and carried through as a whole, instead of working from point to point, a considerable economy of labor is generally realized. Superintendence expense will also be reduced. The contractor will not have to appear personally on the work several times every day to see than his foreman has not been compelled to suspend the work through uncertainty of the proper procedure.

It is obvious that careful engineering work will improve the calibre of the installation. The contractor can feel, therefore, that his reputation is certainly not suffering through association with a creditable job. If difficulties arise in the work and changes are required that call for extra compensation, the contractor can readily satisfy the engineer as to the justice of his claim. The client alone is often unduly suspicious and hard to handle.

Engineer and Architect

The relation of the architect to interior electrical work is a peculiar one. In the past he has had this work thrust on him, since there was no one else to handle it. In the early stages there was rarely anything more involved than ordinary house wiring. This perhaps required the services of an engineer no more than the erection of a wood-shed required the services of an architect. To-day, however, many commercial installations are important enough to be distinctly engineering propositions. Under such circumstances it is not fair to any of the interested parties for the architect to attempt to handle such work himself. If he is a first class architect he will not have been able to become a first class electrical engineer at the same time. The electrical engineer does not find that he can become proficient in architecture by studying it as a side line or hobby. One science is quite as complex as the other. It is true that some architectural firms may have enough big electrical work to employ a competent engineer themselves. But such cases are very rare exceptions. In the general case, therefore, it is not fair to the client nor to his own reputation for the architect to attempt to handle work for which he is not absolutely competent. This fact has been realized by many of the better firms, who to-day are calling on the services of electrical experts to help them out. By so doing the architect is more likely to have an electrical installation in his building that will measure up to the high quaality of his own architectural work.

Unfortunately the basis on which these relations have been built has not always been entirely satisfactory. The architect has still shouldered the responsibility toward the client, and has made the engineer answerable to himself Frequently, too, he has been tied down by the scale of his own fees, and been forced to offer the engineer a remuneration too low to be productive of the best results. A percentage which may prove adequate as applied to a whole building may be entirely insufficient on a special feature. The amount of detail may require and merit much greater work in proportion to the cost.

The real solution would appear to rest on the education of the business public to deal directly with the engineer in engineering matters, thus relieving the architect of all responsibility in these matters. The architect should not resent this as an infringement of his rights. In most cases it will affect his fees very little, if at all. In any case the difference will be inconsiderable compared to the advantages. He will be relieved of the responsibility of something which is a little out of his line. He will be relieved of an amount of work which can scarcely leave more than a trifling profit on this item. And he will see an installation go into his building that will be creditable to all concerned.

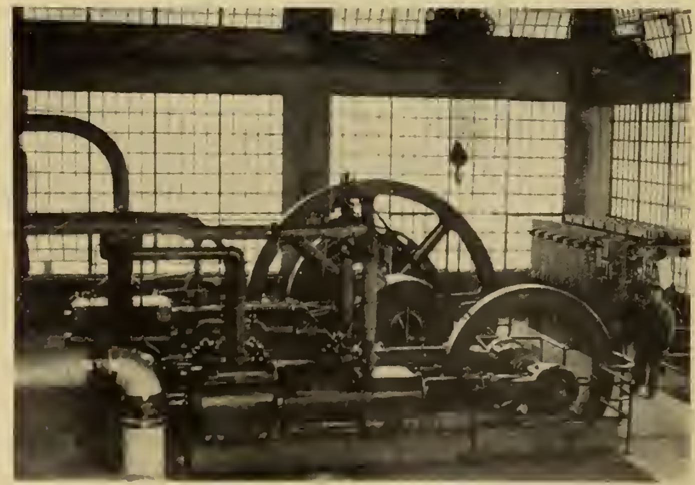
There is no insuperable obstacle to the direct dealing of both architect and engineer with the client. The points wherein the work of the one comes in contact with that of the other can easily be adjusted by a little mutual agreeability. The time and trouble taken in setting such points should be quite negligible.

The electrical equipment of most modern commercial enterprises is a question vitally affecting its success. The business man can no longer afford to allow the matter to be handled by carelessness or incompetence. He can not afford to attempt to work out his own salvation. He cannot afford to entrust the matter to anyone but an expert. He needs the engineer and needs him badly. To get the best results he must be in close personal touch with the engineer.

Isolated Plant for M. C. R. in St. Thomas

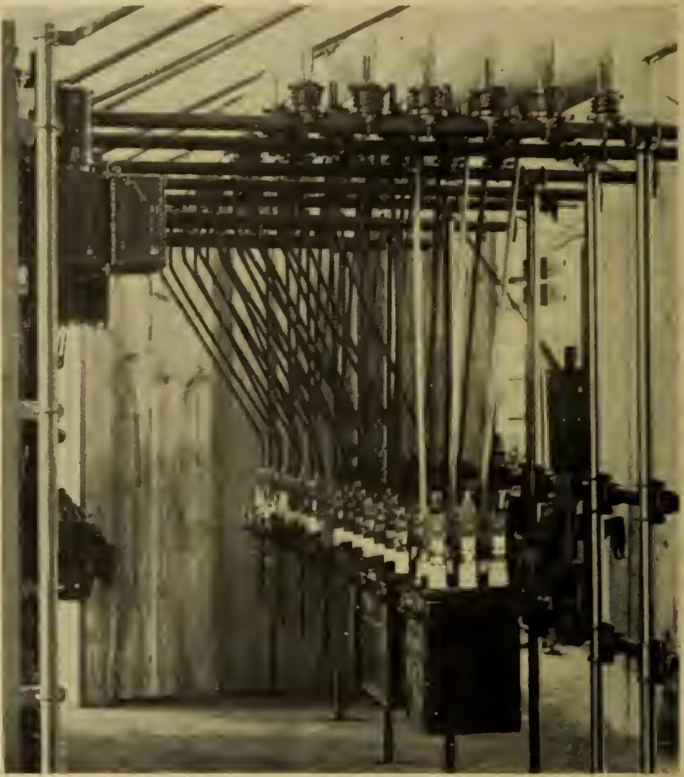
In order to prevent, if possible any interruption to the work in their shops at St. Thomas, Ont., which may result from electric disturbances of any kind on the high tension transmission line of the Hydro-electric Power Commission of Ontario, the Michigan Central Railway Company have recently added to their electrical plant a complete engine-driven electric generator unit. The electric equipment was supplied by the Canadian General Electric Company.

The engine was furnished by E. Leonard & Sons and is of their extra heavy duty type; cylinder size 24-in. x 42-in.; working pressure 150 lbs.; 100 r.p.m.; rated horse-power 500. This engine is used for supplying power for the various shop machines, cranes, etc., which are all direct connected to motors. The exhaust steam is used for heating. The engine is equipped throughout with a complete Nugent oiling system, including filter, through which the oil is passed after being used in the engine. It is then used over again, enabling the engine to operate continuously with a very small oil consumption.



Engine-generator plant of M. C. R. Co.

The generator is 375 kv.a. capacity, 100 r.p.m., 3-phase, 25-cycle with belted exciter 18½ kw., 600 r.p.m., 125 volts. The equipment in the power house also includes three single-phase transformers each 225 kv.a., 13,200/575 volts, these for obtaining the supply from the St. Thomas Commission's lines. The low voltage transformers include a 50 kv.a. unit 550/127/220 volts and one 25 kw. unit 550/127/220 volts.



Rear of Switchboard—M. C. R. Co., St. Thomas.

An item of particular interest is the switchboard which consists of nine natural black slate panels, 90-in. high, mounted on pipe supports, there being six feeder panels, one combination exciter and a.c. generator panel, one T. A. regulator panel and one combination incoming line and transformer panel. There are two sets of 575 volt bus-bars, one set being connected to the generator and the other to the 13,200 volt incoming line through a bank of transformers. All feeder circuits are equipped with double throw oil switches so that they can be operated on either set of busses. This produces a very flexible system and minimizes shop shut-downs due to either interruptions on the Hydro-electric System or to trouble with the generator.

Oil switches, bus-bars and instrument transformers are mounted on pipe framework back of the switchboard, see figure, and all apparatus is hence easily accessible. There is absolutely no crowding of apparatus so that the factor of safety is high both as regards the apparatus and the operators and yet the switchboard is compact.

The various circuits are equipped with the usual devices for this class of service except that the incoming line panel includes also a curve drawing power-factor meter and a curve drawing wattmeter. Each automatic oil switch is controlled by a time limit overload relay, thus preventing unnecessary shut-downs due to the momentary disturbances.

The Arnold Company, Chicago, were consulting engineers.

Electricity on the Ontario Farm

A few figures showing the results of two years pioneer work among the farms of South Western Ontario by the Hydro Electric Power Commission of Ontario

The employment of mechanical drive on the farm for the operation of threshing machines, ensilage cutters and elevators, circular saws, grinders, water pumps, pulpers, milking machines, butter workers, cream separators, churns, fanning mills, etc., can hardly now be considered of recent origin but the adoption and utilization of the electric motor for power purposes on Ontario farms is just at present of paramount interest.

The electric motor when compared with other types of prime mover, especially the steam tractor and explosion motor, possesses salient advantages both as regards efficiency and fire hazard, and, as a result, is worthy of the most careful consideration in connection with farm power installations. Electric energy also offers, in addition to other advantages, a simple and economical conversion into either light or heat, and is therefore particularly adapted to farm service.

The inherent advantages of the electric motor and also of individual drive are already too well known to require re counting in this article, but the results which are printed in the following pages and which have been secured after the most careful experiments and investigations, may prove of interest to those who are not already cognizant with the work the Hydro-electric Power Commission has accomplished in various parts of the rural districts of the Province of Ontario.

Demonstrations

Early in the Fall of 1912 the Commission, after extensive investigation both on this and the European continent, designed and constructed two twenty-five horse-power electric motor outfits for use in the rural districts during the threshing season. These outfits, each consisted of two Bain wagon gears upon one of which was mounted a 25 h.p., 3-phase, 220 volt, 25-cycle motor and auto starter, and upon the other three 20 kw. 2200/220/110 volt transformers, an oil switch, lightning arrester and meter. Both the motor and the transformer wagons were provided with covers and hauled from place to place by horses, the motor being operated at the various farms through a connection to the transformers and the 2200 distributing lines of the Commission.

Threshing and silo-filling were performed throughout the season with these outfits and the results secured were much better than were anticipated. However, the 25 h.p. outfits were expensive, and, although they were economical in operation, the Commission decided to experiment with a smaller outfit. Accordingly, during the early part of the Fall of 1913, a small threshing machine, ensilage cutter and 5 h.p., 3-phase, 110 volt, motor were purchased and from the actual operation of these machines additional data on threshing and silo-filling was secured. The smaller outfit and machines were found to be more nearly adapted to use on the smaller farms of Ontario, since they could be operated economically and might be purchased for a small amount. In addition, the 5 h.p. motor might be utilized during the remainder of the year for other operations on the farm.

Naturally where the smaller outfit and machines were employed the threshing and silo-filling operations extended over a slightly longer period, but on the other hand, these operations, as will be seen form a table which appears later, were accomplished at a lesser expense, especially when compared with "contract" work.

The data secured with these outfits together with that collected at a few of the several demonstration farms, is given in the pages which follow.

General

The Hydro-electric Power Commission of Ontario is at the present time supplying approximately 150 farms with electrical energy for either power, lighting or heating purposes. The majority of these farms are located in the south-western parts of the Province in the Townships of Toronto, North Norwich, South Norwich, North Yarmouth, South Yarmouth, North Oxford, East Oxford, West Oxford, East Flamboro, East Zorra, Grantham, Ancaster, Downie, Puslinch, West Nissouri, Blandford, Waterloo, Wilmot and Westminster, and are supplied from the Niagara transmission system of the Commission with power generated at Niagara Falls.

The greater portion of these farms is located adjacent to the transmission and distributing lines of the Commission for otherwise the cost of distributing and supplying these customers with power would prove excessive, and the proposition would not therefore present economic possibilities.

The interest evidenced by the farmers and the residents of the smaller villages has greatly aided the Commission in their efforts during the past year to promote an increased use of electricity for lighting, heating and power purposes in the rural districts of Ontario. Rural distributing systems to supply farms and small villages have already been constructed or are at the present time under construction in a number of townships. Where the amount of power sold to a district is large enough to warrant supervision by the township, this business is generally handled by the township itself, otherwise the nearest town handles the work until the system has grown sufficiently to warrant the township taking charge. This arrangement to date has proved very satisfactory since it permits of the establishment of a number of demonstration farms in various parts of the province, and made it possible for the rest of the township to profit by graphic examples of the many uses of electric power on the farm. In addition, much useful information has also been collected on these farms and this has been utilized in preparing recommendations as to the most suitable installations for the average farm under various conditions and also in arriving at the proper system of charge for the different kinds of service.

Classes of Service

There are three classes of consumers in the rural district. First, the consumer who merely wants power for illuminating purposes; second, the consumer who wants power for lighting purposes and motors with a rating up to and including 5 h.p., and third, the consumer who wants power for lighting, small motors, and a large 20 h.p. outfit, the latter to be used for such work as threshing and silo-filling.

The first class of consumer—in fact, all consumers who have motors rated at less than 2 h.p.—are supplied with single-phase energy at 110 volts pressure. The second class of consumer, i.e., those employing motors rated at 5 h.p., are supplied with three-phase energy at 110 volts pressure, while the third class of consumer, generally consisting of a syndicate comprising seven or eight farmers who have purchased a portable 20 h.p. motor and transformer outfit (similar to those employed by the Commission during the Fall of 1912) for use in common, to accomplish their threshing and silo-filling, are supplied with three-phase energy at 2200 volts pressure supplied directly from the distributing lines of the Commission.

Service Charges

The Hydro-electric Power Commission, as has been previously stated, is endeavoring by every possible means to supply the farms of Ontario with cheap electrical power. The actual cost of supplying this energy, of course, depends directly upon the number of consumers per mile as well as the aggregate load of the district, since the service charges collected from these consumers are employed to pay the interest and maintenance charges on the distributing lines. These service charges amount to about $10.00 per mile of line per month, so that where there is an average of three consumers per mile, each is required to pay a service charge of $3.00 or $3.50 per month, while with an average of five consumers per mile the charge is found to be about $2.00 per month per service.

Procedure for Power Supply

The method of procedure to be followed by those farmers desiring a supply of electric power in districts not already served is clearly outlined in "The Power Commission Act of 1911 (1 George V. Chap. 14)." To those not already familiar with this legislation the following resume may prove of interest.

The farmers or ratepayers of the township or district desiring to purchase electric power from the Commission are first required to canvas their district and ascertain the probable amount of power which can be sold in the district. The information thus obtained is then forwarded together with a petition for a supply of power to the township council, who, in turn, apply to the Hydro-electric Power Commission for an estimate on the maximum cost of power to be supplied by the Commission. Estimates are submitted by the Commission after the most careful investigation and only then if the proposition appears feasible. The township is then required to secure contracts with the various ratepayers or farmers petitioning and later, sign a contract with the Commission for a definite amount of power.

Distributing System

All rural distributing systems are constructed by the Commission and generally supplied with power from the substation or stations located in the nearest town or towns in the vicinity. In case there are no adjacent stations of this sort but where the 13,200 volt lines pass through the township, 13,200/2,200 volt pole type transformer stations are usually built.

The power is transmitted at either 2,200 volts or 4,000 volts, three-phase. The conductors consist of No. 6 hard drawn copper wire which are carried on 5,000 volt insulators mounted on 4 pin arms, the latter erected on 25 ft. to 30 ft. poles. All poles are bought in accordance with standard specifications prepared by the Commission. The primary circuit or circuits, as the case may be, are carried on either one or two 4-pin arms. The secondary circuits being carried on Peirce brackets erected at lower points on the poles. The lines are designed for initial operation at 2,200 volts, delta. When the distance of transmission is increased or the capacity of the line is found to be insufficient for economic operation, the system may then be changed over to operate at 4,000 volts Y by the addition of a No. 6 copper clad steel wire neutral carried either on the fourth pin of the cross arm or erected at the tops of the poles on ground wire clamps and the necessary changes made in the transformer connections. The neutral wire is permanently grounded at frequent intervals. The estimated cost for this type of construction is about $1,000 per mile.

Each farmer as a rule is supplied from a separate transformer, except in cases where two farms are situated directly opposite each other on either side of the road. The power is sold, depending upon the choice of the consumer, either at a meter rate (kilowatt-hour) or on a flat rate contract.

The farmer is required to provide all poles, wires and other equipment located on his premises. The township supplies only the connection to the first pole on the property of the consumer and also the meter when one is required.

The costs of wiring the different buildings of the farm vary from $1.25 to $2.00 per outlet for open work and from $2.50 to $3.50 per outlet for concealed work.

Wiring Recommendations

The Commission is at present engaged in preparing recommendations, as to the most suitable installations which will give the maximum amount of safety for the minimum outlay in connection with the wiring of barns and farmhouses, special precautions being recommended in the wiring of barns and outbuildings in order to secure reduced fire hazard.

Electrical Installation

The usual electrical installation recommended for a 250-acre farm consists of a complete lighting system employing 25 to 40 watt metal filament lamps in the house, barn, cow stable, etc., two 100 watt metal filament lamps in the farm yard and one 100 watt metal filament lamp outside the entrance to the farm on the road. A 5 h.p. motor permanently installed in a suitable location in the barn so that a milking machine, grinder, and in some cases, a water pump, may be easily operated from a single counter shaft, is further recommended for power purposes. Frequently it is found necessary to install a smaller motor for operating the water pump or a cream separator and churn in the milk house. Another appliance recommended is a water heater which may be installed in the milk house and comprises a 20-gallon can insulated to reduce heat losses and equipped with an electric heater. The heating unit consists of a 600 watt bulb designed to raise the temperature of the water in the can to boiling point in a few hours. This appliance provides a sufficient supply of boiling water with which to wash out the milk cans at all times.

The Commission has also made careful investigation and secured considerable data in connection with the power required to thresh various kinds of grain and fill silos. Outfits requiring from 5 to 20 h.p. for their operation are now recommended for use on those farms situated adjacent to the 2,200 volt distributing lines.

Rates

The rates charged the rural customers for power at the present time consist of a service charge and either a flat horse-power rate or a kw.h. rate per month, the former charge being based on the connected load and the latter being determined by meter. These rates, of course, are influenced more or less by several considerations and since the consumer is generally one who is unfamiliar with the uses and measurements of electric power, it is desirable that the rate be one that can be readily understood. On the other hand, the load factor varies considerably in the different townships, and it is therefore almost impossible to secure any base characteristics upon which to work.

The service charges in all cases are required to cover the annual interest charges on the capital invested in the line as well as the maintenance costs. These may therefore be easily determined. On the other hand a careful study of the load-factor of the rural load is necessary in deciding upon the power rates. The service charges up to the present range from $1.50 to $3.50 per month. The power rates at a flat rate per month range from $20 to $50 per year per h.p., or at a kilowatt-hour rate of from 4c to 7c per month which is frequently subject to a 10 per cent discount for prompt payment.

The following table gives the rates at present charged in the various townships.

Table 1.—Rural Power Rates

Name of Township	Fixed Service Charge per month	Meter Rate per Kw-hr. per month	Alternative Flat Rate per h.p. per year
Toronto	$2.00	......	$36.00
West Oxford	3.00	†4½c	30.00
Waterloo	2.00	†5c	30.00
North Norwich	2.00	4c	36.00
North Yarmouth	3.00	......	35.00
South Yarmouth	2.00	......	36.00
North Oxford	2.00	......	36.00
Downie	3.00	5c	30.00
Grantham	2.00	†4½c	22.00
Wilmot	1.00 per h.p.	Power 5.1, 3.4, 0.4c	.....
South Norwich	2.00	.....	36.00
East Oxford	2.00-3.00	......	36.00
East Zorra	1.00-3.00	†5c	.....
Westminster	2.00-3.00	......	40.00
West Oxford (Extension South of Beachville)	2.50	5c	30.00
Ancaster	2.00	5c	30.00
Puslinch	2.00-3.00	......	24.00
West Nissouri	2.00-3.00	5c	40.00

†10 per cent. discount for prompt payment.

From the above table it will be seen that the rural distributing lines serve a number of farms in the various townships. In addition to these, they also serve the Villages of Clarkson, Cooksville, Dixie, St. Agatha, Petersburg, Sebringville and Breslau.

Load-Factor

During the past year a careful study has been made of the load-factors in the rural districts and it was found that these varied considerably in the different townships. The diversity is undoubtedly due in a large part to the temperaments of the consumers and the periods at which they elect to operate their equipment. Some of the more ambitious start their work at 5 or 5.30 o'clock in the morning, while many others take things easier and do not do their milking until between 7 and 8 o'clock. The milking and separating are approximately the only operations which must be performed at a stated time each day and even though the times assigned for these duties vary on the different farms, these variations seldom exceed an hour in time and are therefore to be expected. The milking period, especially in the dairy sections, is practically the prevailing factor in establishing the peak loads for sections. On the other class of farms it is practically impossible to impose restrictions with farm work which would improve the load-factors as has been done on the so-called demonstration farms where the grinding is done in the afternoon and the pumping at some other opportune time during the day to secure the proper diversity factor.

The following table gives in detail the results with respect to load-factor secured on seven different farms in West Oxford Township. These farms are served from Ingersoll.

Table II —Load-Factor

Record of Power Consumption

Farmer	Amount of Contract	Use	Amount Paid	Kw-hr. for 1 year	Load Factor 5650 hr.	Load Factor 8760 hr.
J. Prouse	2 h.p.	Light & Power	$58.53	363 367 730	20%	51%
W. Bowman	2 h.p.	Light & Power	Minimum $50.00	226 226 452	15.8	4.3
W. O. Edwards	1 h.p.	Light	Minimum $25.00	169	6.2	2.5
D. W. Clarke	2 h.p.	Light & Power	$64.45	206 343 549	10	4.2
R. E. Edwards	1 h.p.	Light	Minimum $25.00	243	8.9	3.7
K. S. Memulkin	1 h.p.	Light	Minimum $25.00	122	4.45	1.85
J. Lick	1 h.p.	Light	Minimum $50.00	210	7.7	3.2

Cost of Operations

The average costs for the various operations which were secured on four of the Demonstration Farms are given below, also data in connection with the costs of threshing and silo-filling, secured during the Fall of 1912 with the 25 h.p. outfit and during the Fall of 1913 with the 5 h.p. outfit.

Table III.

Raymond & Son, North Oxford Township, Oct. 22nd, 1912, to Oct. 22nd, 1913.

Operation or Appliance	Detail of Work	% of Total Kw-hr.	Cost $ c	Unit Cost	Notes
Grinding	500 bush. of oats	1.4	1.32	.26c per bush.	
Milking	680 times (Max. 30 cows) (Min. 14 cows)	28	26.93	.18c per cow per milking	
Fanning Mill	10 hours	.1	.11	.91c per hour	
Pulping Roots	30 hours	.7	.70	.233c per hour	
Cutting dry corn	60 hours	1	.95	.135c per day	
Heating water	325 times	3.7	3.52	.432c per gal.	
Sawing wood (drag saw)	20 hours	.4	.35	1.75c per hour	
Air heater	2.080 hours	35.5	33.86	1.62c per hour	
Toaster	91 times	.2	.16	.176c per time	
Electric iron	84 hours	.8	.74	.88c per hour	
Washing machine	84 hours	1.2	1.18	1.42c per hour	
Lighting		27	25.84	1.84c per kw.h.	
Threshing			.....	....	Steam
Silo-filling	16 ft. x 42 ft. silo, 211 tons (Estimated)	....	6.96	3.3c per ton	Extra over contract

Table IV—Record of Power Consumption

Township	Farmer	Contract	Service Charge per Annum	Power Charge per Annum	Total Cost per Annum	Kw-hr. per Annum	Load Factor 5650 hr.	Load Factor 8760 hr.	Average Cost per Kw-hr. S. C. and Pr.	Average Cost per Kw-hr. Power Only
W. Oxford	Raymond	2 h.p.	$24.00	$36.00	$ 96.00	5435	99.2%	41.3%	1.76c	1.32c
S. Yarmouth	Anderson	2 h.p.	24.00	36.00	96.00	2075	38.5	15.8	4.62	3.48
N. Yarmouth	Cohoon	2 h.p.	36.00	35.00	106.00	5559	101.1	42.2	1.91	1.38
N. Yarmouth	Penhale	2 h.p.	36.00	35.00	106.00	4651	85	35.4	2.28	1.5
W. Oxford	Innes	2 h.p.	36.00	30.00	96.00	4803	88	36.6	1.98	1.24
W. Oxford	Karn	2 h.p.	36.00	30.00	96.00	4927	90	37.4	1.93	1.22

Table V.

R. A. Penhale, North Yarmouth Township, March 16th to Oct. 18th, 1913

Operation or appliance	Detail of Work	% of Total Kw-hr.	Cost $ c	Unit Cost	Notes
Pumping water	4 hr. per day ... ... (6,125 bbl.)	28.3	17.75	.11c per bbl.	
Milking	421 times—30 cows	23.7	14.98	.12c per cow per milking	
Separating cream while pumping	316 times	8.2	5.20	1.1c per hour	
Heating water	2,420 gals.	29	18.35	.7c per gal.	
Lighting	... ...	10.8	6.74	2.74 per kw.h.	
Sawing wood ... ... Threshing ... ... Silo-filling	... ...	....	.....	....	By his steam engine.

Table VI.

Alex. Anderson, South Yarmouth Township, Dec. 13th, 1912, to Nov. 13th, 1913.

Operation or Appliance	Detail of Work	% of Total Kw-hr.	Cost $ c	Unit Cost	Notes
Grinding	2,800 bush. oats and wheat, mixed	45	39.60	1.41c per bush.	
Milking	By machine, while testing it 14 times	2.7	2.38	Testing Machine	
Pumping	Using Jerker just put in ...	.9	.79	....	Windmill mostly Jerker, just put in
[illegible]					
Heating water	2,724 gallons	19.7	17.34	.63c per gal.	
Electric iron	120 hours	2.9	2.55	2.1c per hour	
Lighting	... ...	28	24.63	4.62c per kw.h.	
Sawing wood	8 hr.—25 cords stove wood .	.8	.71	.27c per cord stove wood	
Threshing and silo-filling ..	... ...	....	.....	....	By steam this year

Table VII.

Ezekiel Cohoon, North Yarmouth Township, Mar. 18th to Oct. 18th, 1913.

Operation or Appliance	Detail of Work	% of Total Kw-hr.	Cost	Unit Cost	Notes
Milking	30 cows, 224 times	11.7	7.37	.11c per cow per milking	
Heating water	3,000 gallons	37.6	23.69	.8c per gal.	
Separating cream	60 hours	1.4	0.88	1.45c per hour	
Electric iron	16 hours	.3	0.20	1.25c per hour	
Pumping	856 hours	26.4	16.56	2c per hour	
Lighting	... ...	22.6	14.25	2.15c per kw.h.	
Silo-filling ... ... Threshing	... ...	....	.....	....	By steam engine

Table VIII —Threshing Data

Farmer	Township	Date	Outfit	Grain	Average h.p.	Quantity in bush.	Total Kw. h.	Total cost at 3c. per Kw.h.	Cost per bush.
John Rowse	W. Oxford	10/13	25 h.p.	Wheat	27.2	265	87	2.61	.98
John Rowse	W. Oxford	10/13	25 h.p.	Oats	19.6	1179	165	4.95	.42
Wm. Bowman, Jr.	Dereham	10/13	25 h.p.	Oats	22.2	1190	141	4.23	.36
Geo. Raymond	S. Oxford	10/13	25 h.p.	Oats	24.5	1140	203	6.09	.53
Jas. Innes	W. Oxford	10/13	25 h.p.	Wheat	24.3	476	93	2.79	.58
B. C. Edward	Dereham	10/14	5 h.p.	Wheat	4.8	375	7	.21	.57
B. C. Edward	Dereham	10/14	5 h.p.	Oats	4.8	368	25	.75	.2
W. C. Edwards	Dereham	10/14	5 h.p.	Oats	4.6	290	17	.51	.17
J. C. Karn	W. Oxford	10/14	5 h.p.	Oats	4.5	50	2.9	.09	.17

Table IX.—Silo-Filling Data

Farmer	Township	Date	Outfit	Average h.p.	Quantity in tons	Total Kw-hr.	Kw-hr. per ft. ton	Total cost at 3c. per Kw-hr.	Cost per ton
John Leigh	W. Oxford	10/13	25 h.p.	25.9	108	215	.060°	6.45	5.9
Wm. Bowman, Jr.	Dereham	10/13	25 h.p.	22.4	175	336	.051°	10.07	5.8
Jas. Fordon	N. Oxford	10/13	25 h.p.	25.5	125	197	.042°	5.92	4.7
S. J. Prowse	Dereham	10/13	25 h.p.	19.6	189	392	.055°	11.77	6.2
B. C. Edward	Dereham	9/14	5 h.p.	7.2	72	116	.050°	3.48	4.8
W. C. Edwards	Dereham	10/14	5 h.p.	7.2	96	147	.048	4.41	4.6
Geo. Raymond	N. Oxford	10/14	5 h.p.	4.9	211	232	.029†	6.96	3.2
D. W. Clarke	W. Oxford	9/14	5 h.p.	5	100	48	.023†	1.44	1.4

°Blower type of ensilage cutter.

†Carrier type of ensilage cutter.

The Development of Our Water Powers

And the Effect on the Progress of Canada

By L. A. Herdt, D.Sc., F.R.S.C.

It will be my aim in the short time at my disposal this evening to review the work on this Continent by electrical and hydraulic engineers in the development of one of our greatest natural resources—water powers—which development effects a conservation of the other natural resources of the country.

The development of water power effects a conservation of the fuel supply of the country. Electrical energy can be produced indirectly from the consumption of coal, oil, natural gas and other fuels, but electrical energy so produced is at the expense of the production of large quantities of wasted energy in the form of heat, and nature's store of potential energy in these fuels is prodigally wasted. It is a good and economical steam plant which is able to utilize ten per cent of the energy of the fuel; the rest is wasted. The hydro-electric plant is capable of utilizing as much as seventy per cent of the energy of a waterfall and thus the use of hydro-electric power is a factor helping to conserve the fuel supply for future generations. The supply of the fuels is not inexhaustible and much concern has been felt at the prospect of partial or total exhaustion of the coal deposits. The generation of electrical energy by water power does not deplete the source of supply. Water power is, perhaps, unique amongst natural resources—it is not diminished by use, nor is it conserved by non-use. Coal, which is not used to-day remains to be used hereafter, but the water has passed to the sea. From this standpoint the importance of placing these inexhaustible stores of energy at the service of man is obvious and the systematic and scientific development of water powers may be well considered a work of true conservation, and therefore a work of national importance. This country which has been abundantly blessed with this "white coal" or perhaps I may call it never failing run of oil, is intimately concerned that hydro-electric works be well conserved and intelligently executed.

It has been estimated that to operate the individual enterprises and public utilities of the United States and Canada, excluding steam railways and vessels, that not less than 30,000,000 horse-power is required. In 1913 it was estimated that over 7,000,000 h.p. 12 hours a day was generated from water power in the United States and Canada. This leaves 23,000,000 h.p. 12 hours a day generated from fuel—mainly coal. Assuming that under average conditions one horse-power-hour can be produced in a steam plant from three pounds of coal, this 7,000,000 h.p. represents a saving of 33,000,000 tons of coal per year.

In 1911 the total amount of bituminous coal and anthracite coal mined in the United States and Canada was approximately 547,000,000 tons. As previously stated it is computed that in the conversion of the energy of coal into useful work in the steam plant we are throwing away at least 90 per cent of the energy of this coal.

The railroads are probably the most inefficient users of coal. Even with the best steam locomotives, only the smallest fraction of the energy of the coal consumed is obtained as power. Most of it goes through the smokestack and in the exhaust from the cylinders. Steam locomotives in the year 1911 used more than one-fifth of the 547,000,000 tons of coal mined; that is, over 100,000,000 tons of coal a year is shovelled into the grates of the steam locomotives in the United States and Canada. The electrification of railways and the use of hydro-generated electric power for the purpose of propulsion is becoming more and more of a necessity. We should also consider the reduction of fire waste in the forests due to the elimination of the spark shedding locomotive as an additional return to the nation on the investment.

Let us turn from this matter of conservation of our fuel supply and consider another aspect of the question. The most convenient method of utilizing energy is in the form of electrical power and such electrical power can be now transmitted economically hundreds of miles from the source of supply. In this country of ours, with an abundance of water power ready at hand, the energy furnished free of cost by nature itself, it is, I believe, within reason to hope that the use of coal for power purposes in our large cities will before long be almost entirely abandoned and that hydro-electric power, economically transmitted and distributed, will in time light every home and drive every factory in this country. Even now the public is dependent in most cities every day upon one or more of the manifestations of this hydro-electric energy. Electric power, heat, light, transportation by electric cars, are incessant manifestations of this force. These are no longer luxuries but necessities of our domestic life. It is a fact, however, that many people who rely on this very docile and obedient servant for the conveniences and some of the necessities of life little know of the strict course of discipline which has to be maintained to keep that same servant in his place, or of the many years of patient research and tireless endeavour before the proper code of rules to be enforced to govern the department of that servant had been formulated.

Long distance transmission of electric power dates from the year 1882, when Monsieur Marcel Deprez at the Munich Electrical Exhibition transmitted about one horse-power a distance of 35 miles to a place called Wiesbach. Direct current at 1,300 volts was used and the transmission line was an ordinary telegraph circuit of iron wires.

In 1891, one hundred horse-power of electric energy was transmitted from Lauffen to Francfort, a distance of 81 miles on three copper wires, carried on insulators in a way very similar to that used at the present time. This was an alternating current transmission at 40-cycles, 3-phase, 8,500 volts. It was built for demonstration purposes only.

Some wonderful feats in electric power transmission have been accomplished since that date. The voltages have steadily risen from a few thousand volts in 1891 to the voltage of 150,000 volts of the Pacific Light & Power Company of Los Angeles, California. This company is transmitting over 100,000 h.p. a distance of 240 miles at this voltage—the highest commercial voltage known to-day. The company has over 1,180 miles of high voltage lines. The Southern Power Company in Maryland operates approximately 350 miles of 100,000 volt lines. It covers half-a-dozen States in the Union, generating and transmitting over 75,000 h.p. Practically every city and town in the Province of Quebec, Ontario, Manitoba and British Columbia is largely supplied with light and power generated through hydro-electric development. Quebec City and the surrounding districts obtains its electric current from the Montmorency and Chaudiere Falls; Montreal and the surrounding districts from Shawinigan Falls, 85 miles away, also from the Lachine Rapids, the Richelieu River, the Beauharnois Canal; again a large development on the St. Lawrence River at the Cedar Rapids is now in course of construction, with initial development of 100,000 h.p. Ottawa City obtains its power from the Chaudiere Falls —large developments are there in existence and extensions are now under construction. The whole of South-western Ontario, including Toronto, obtains its power from Niagara Falls. In the West, Winnipeg is amply supplied with hydroelectric power from plants built on the Winnipeg River; Vancouver and the Pacific Coast towns are supplied by large hydro-electric plants—the largest of which is that of the Western Canada Power Company, with a maximum development of nearly 100,000 h.p.

The prodigal displays of nature's might at a waterfall or rapid, when intelligently harnessed and converted into electric power, can be transmitted and distributed economically in a territory covering hundreds of square miles. This is the work of the electrical engineer and he is surely playing a leading part in the drama of human progress.

The tremendous development in the application of electrical energy which has taken place in the last ten years is to a large extent a result of the progress which electrical engineers have made in the economical transmission of electrical energy over long distances. This has rendered possible the supply of electrical energy for industrial, domestic and other purposes by tapping these sources of energy which exist in the innumerable rivers and streams flowing to the sea from the high lands.

Battery with Machine Pasted Plates

By J. D. Lachapelle

The Vital Factors in Storage Batteries

The quality of its plates more than any other factor determines the kind of service a storage battery will give. Look at a battery plate and you will see the outlines of a grid or latticed metallic frame buried in the body of the plate. The body is composed of a substance which has been compacted into the grid. When the battery is in service this substance is in a state of great chemical activity and is, therefore, known as the active material. The grid holds the active material in position and acts as the conductor of electric current into or out of the plate. Other things are important in battery service, but the active material is of paramount importance.

There is a stage in the making of battery plates where we have empty grids and paste. It is the paste which, after being applied to the grid and going through an electrochemical treatment, becomes the active material. The latter inherits its potent qualities from the paste—it is simply the paste transformed.

Paste is, therefore, of the utmost importance—so far as service given the owner of an electric car is concerned, the paste is the battery and it is on paste that the researches of many clever chemists have been centered. However, experience has shown, also, that the paste in its final effects is as good or as poor as the method used in applying it to the grid. Paste and pasting are, therefore, the vital factors in making storage batteries.

Homogeneity—The Proof of Excellence in Battery Plates

If, after two pieces of steel are welded, there is one homogeneous whole without crevice or weakness at the joint, the weld is perfect, otherwise not. Cement, Plaster of Paris, etc., may be made plastic by mixing with water, but immediately begin to set and this setting progresses rapidly to a stage where it will prevent one body of cement from adhering to another. Setting is, therefore, a factor to be dealt with in welding into one homogeneous whole certain plastic substances, notably battery paste.

Battery paste sets with extreme rapidity and the possibilities which setting has for defeating the good intent to make high grade batteries are given full scope by the method heretofore used in applying the paste.

In a perfect plate the active material is homogeneous throughout. It is of the same density from top to bottom and from face to face, without hard and soft spots, and adheres evenly to the bars of the grid. Perfectly homogeneous active material could not be secured with consistency by the old style pasting method—chance was too large a factor.

Hand Pasting

Here is a pen picture of old style pasting. In front of the workman is a grid lying flat. Beyond the grid a heap of freshly mixed paste, setting every second it is exposed to the air and also changing chemically because of the active elements within the mass. The workman scoops up a dab of the soft substance and slaps it into the upper side of the grid. With great energy, and using his strength, he manipulates the paste, rubbing it back and forth with peculiar flourishes of his trowel. Working at top speed he gradually succeeds in getting the paste into the mesh of one side of the grid. Then he flops the grid over and hurries to get the other side pasted before plasticity fails. The time consumed in hand pasting permits "setting" before it is desirable, particularly over the surfaces where the paste applied on the second side meets the paste applied some time before on the first side. The result is an uncertain weld and a more or less imperfect adhesion to the bars of the grid. The defects of hand pasting, therefore are:—

The machine pasted plate.

1st. On each side a variation in density of the material with hard and soft spots regardless of the expertness of the workman.

2nd. The principal causes of weakness and uncertain electrical efficiency hidden in the heart of the plate where it is vital that conditions be definite.

The result was an uncontrollable lack of uniformity in the behavior of different parts of the plate when put into service and in the behavior of one plate as compared with its neighbor and of one battery compared with another in the same service. The personal equation among workmen always counts, but, even so, the quality of plates produced by the best workmen varied, due to causes beyond his control. There was too much luck in the process. Homogeneity in the active material could not be assured, and the resulting variation in the behavior of batteries was a disturbing element in the battery business. However, the defects inherent in old style hand pasting are now avoided by a new process, and uncertainty gives way to certainty. The answer to the problem has been found in the "machine pasted" plate.

The Machine Idea—Obviously Correct

Assume that the paste could be applied by means of a machine. At the top is a hopper containing the paste. Battery grids are fed into a slot just large enough for the purpose and disappear into the heart of the machine, where the mechanism forces the paste into both sides of the grid simultaneously. The two masses of paste which approach each other are of identical composition. Setting is postponed until after the pasted plates emerge from the machine. Thus there is an absolute weld, perfect adhesion to all the grid bars and uniform density throughout. The thing desired, homogeneity, is achieved and with it the elements of durability and electrical efficiency.

This is no new idea. Battery engineers have wrestled with it for years. The thing that balked them was the paste—it would not work right in the machine, would not flow properly into the mesh of the grid and fill up solidly without cracks. To find a new paste composition which would work in a machine and yet sacrifice no chemical activity was the problem imposed upon chemists. After years of experimentation the desired end has been achieved, service tests have proven the principle and the "machine pasted" plate is now offered to the public as a product unique in the storage battery business. The active material is of the same composition, density, and hardness from top to bottom and from face to face and in absolute bond with the grid, and thousands of plates may be manufactured with the assurance of uniform service results. Two distinct advantages are offered to owners of electric cars and trucks by machine pasted plate batteries.

1st. Better battery service.

2nd. A guarantee without extra charge.

The frequent imperfect service of old type pasted batteries, and the effect this had on the battery business led to guarantees, but the necessity for protection against the risk caused by the uncertainties of the manufacturing process resulted in an extra price for such guaranteed batteries.

The machine pasted plate battery is the first battery of any type offered to the public with a guarantee for which there is not an extra charge of from 100 to 300 per cent. added to the normal selling price. This battery is guaranteed for either pleasure car or truck service.

These batteries are now being manufactured by the United States Light and Heating Company, Niagara Falls, N.Y.

The A. E. Rittenhouse Company, Honeoye Falls, N.Y., are offering in the Canadian market an exceptionally attractive store window display in the form of a miniature electric areoplane, This toy is operated on four to eight dry cells or on an a.c. lighting circuit with toy transformer and on a d.c. circuit with voltage reducer. The same company also manufacture among other specialties a neat toy transformer with primary 100 to 125 volts and secondary 3, 6, 10 or 20. The only live parts exposed in this transformer are two binding posts, the voltage being controlled by a lever which operates the contacts inside the transformer case.

Phase Advancers—Power Factor Correction

By G. Morrison, M.I.E.E.

The influence of power-factor on an electric supply system is important in several ways. It affects the capital outlay, earning capacity, operating costs and voltage regulation. Operation with low power-factor means that for a given kilowatt output, generators, lines and transformers have to be built larger than would otherwise be necessary. In addition the voltage drop and power losses in lines and transformers are greater and the generator regulation poorer.

In the case of a supply company the total cost of production of the power sold to consumers is determined not by the true kilowatts but by the output of kilovolt-amperes and the company must therefore secure the highest power factor commercially possible or, alternatively, base its charges on a system which will take into account the power-factor of the individual consumer's load. In the case of a manufacturing or mining company having its own electric power plant the same considerations hold and the question is at least as important.

Improvement of Power-Factor

There are in Canada several power companies and manufacturing concerns whose system power-factor is low, the usual cause being induction motors which are either underloaded, or running at reduced speeds or which are of the large slow speed type. The improvement of this power-factor would in almost every case offer advantages whose value would render the additional outlay required to secure them a profitable investment. This is especially true in the case of steam-driven generating plants and those plants where the generators are now being worked at almost full kv.a. capacity. With a better power-factor the same actual kilowatt load can be supplied by a smaller number of units whose prime movers will then be run at a more economical load so cutting down fuel consumption. Again, with the improved power-factor a plant which formerly operated at or near full kv.a. capacity will be able to supply the same true kilowatt load with fewer kv.a. and the balance will be available for additional power demand. These advantages, apart from the others of lesser importance, make it worth while considering the methods of obtaining power-factor improvement which can be divided into two classes. The first class covers synchronous condensers and over-excited synchronous motors and rotary converters. The second class comprises all those devices intended for use in connection with individual motors, one condition necessary for their use being the presence of one or more large induction motors running continuously. The first method is best suited to cases where the motors are small or running intermittently but has some disadvantages, the most important being that the excitation must be adjusted to suit varying load conditions. The second method, which includes the use of phase advancers, the subject of this article, gets right at the cause of the trouble by correcting the power factor of the individual motor.

Phase Advancers

Up to the present time the development of the phase advancer has been carried out wholly by European manufacturers, Messrs. Brown Boveri & Company pioneering the way in this particular line. The advancer which they have standardized is a special three-phase commutator machine which is electrically connected to the slip rings of the motor whose power-factor is to be corrected. The rotor of the machine carries a drum winding, the bars of which lie in slots in an iron core, and are connected to the commutator in a manner similar to the windings of a direct current armature. The smaller sizes of advancer have no stator but in order to provide a closed path for the magnetic field the rotor core is so designed that the winding is at a considerable depth below the surface so that in effect it is surrounded by a closed ring of iron. For very large motors and for special cases a wound stator is used. The theory of the action is simple:—If the motor is running and the advancer standing the rotor current will flow through the advancer and the latter will act as a choking coil causing a reactive drop and a lag in the current. For a given current this drop depends only on the frequency, that is, on the rate at which the rotating field set up in the advancer cuts the winding. If the rate of cutting is reduced by rotating the winding in the same direction as the field, the reactance and therefore the lag decreases, and at synchronism becomes zero.

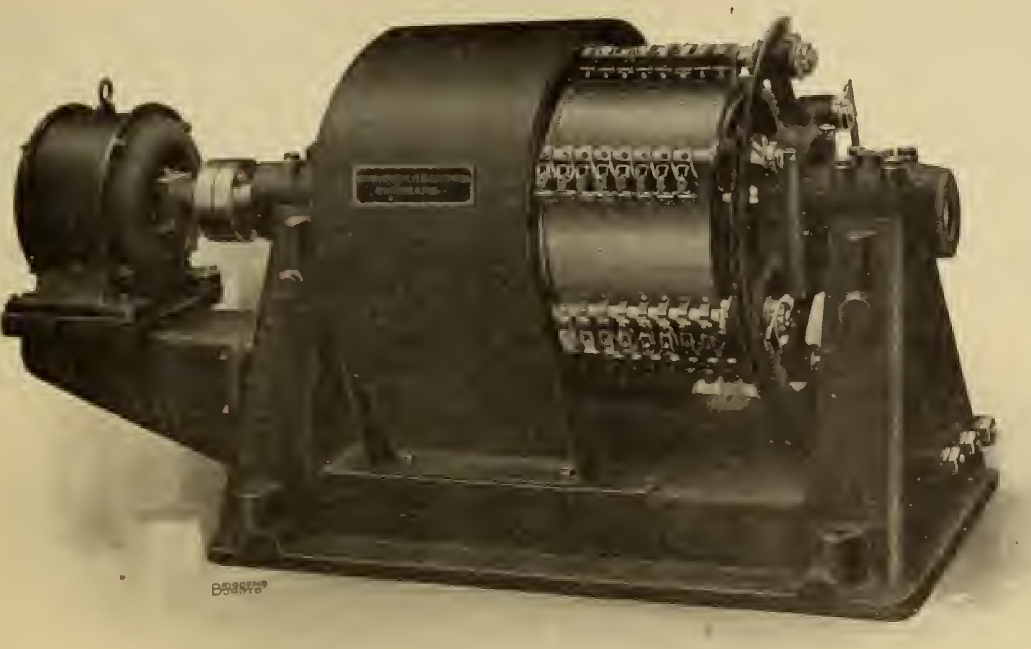
When the speed is raised above synchronism the reactance attains a negative value, the phase advancer acts as a capacity and the current is made to lead. The advancer being run at a speed which gives the required lead the wattless component of the magnetizing current of the motor is provided with the result that the latter takes only watt current from the line, that is, the motor operates with 100 per cent. power-factor. Going still further in the same direction the motor can be given a leading power-factor and so provide the wattless magnetizing current for other motors on the same system.

The driving of the advancer can be done in various ways. It can be direct coupled to the main motor if this is a high speed machine, or if low speed then the advancer can be driven either by belt from the main motor or by a separate small motor. As the current which the advancer supplies is wattless the driving power is small being only that necessary to overcome friction and windage.

The cut shows a Brown Boveri phase advancer driven by a small three-phase induction motor and it will be seen that this advancer has no stator but simply a steel guard for protection.

The connection of an advancer either to an existing motor or to a new one is simple. The leads from the motor slip rings are fitted to a three-pole double throw switch which on one set of contacts connects the rings to the starter and on the other to the advancer. The motor is run up with the starter in the usual way and when up to speed the double throw switch cuts out the starter and connects the slip rings directly to the terminals of the advancer which has already been brought up to its normal speed. The operation of the advancer is then wholly automatic. the power-factor of the motor being kept at 100 per cent or other predetermined value over a wide range of load without any regulation.

A motor when fitted with an advancer maintains its synchronous character and possesses the additional advantage that the maximum torque which can be developed is greatly increased so that heavier overloads can be handled before the motor is pulled up. Its efficiency remains at least as high as when running alone and in some cases it is improved. Further the phase advancer lends itself to improving the performance of large slow speed motors operating on a severe service such as the driving of continuous rolling mills. In such a case the design depends not so much on considerations of heating as on the difficulty of getting a good power-factor without sacrificing mechanical reliability. By the use of an advancer a high power-factor can be obtained and at



Brown Boveri Phase Advancer.

the same time the air gap can be made larger than in the case of an uncompensated motor.

Examples of Benefit

A good example of the benefit derived from the use of an advancer is the case of a 700 h.p. rolling mill motor in an English steel works. This motor works much underloaded and its power-factor adversely affected the efficiency of the works' generating plant which operated at a power-factor of about 55 per cent. An advancer was applied to the motor to raise its power-factor to 100 per cent and when switched in the current taken dropped by 50 per cent. This raised the power of the system to 70 per cent and considerably reduced the production costs as, owing to the decreased amount of wattless current to be dealt with, one generating unit was shut down and the other worked at a load within the capacity of its generator and also economically as far as the steam turbine driving it is concerned.

The advancer of this rolling mill motor was driven at 1,500 r.p.m. by a 2 h.p. motor this covering the maximum amount of power required under any condition of load.

The use of phase advancers is confined to medium and large sized motors and in many cases it will be found possible, by using advancers on one or more of the larger motors and correcting their power-factor to a leading value, to bring the power-factor of the whole system to somewhere in the neighborhood of 100 per cent. The advantage of this as far as increased revenue earning capacity is concerned may be shown by an example.

Taking a system running fully loaded and giving 4,000 kw. at 80 per cent. power-factor, that is, 5,000 kv.a. Assuming two motors, each of 800 h.p., operating at 80 per cent power-factor, have this raised to 100 per cent by the use of advancers. The power-factor of the whole system will be raised to 90 per cent, corresponding to 4,500 kv.a. for the same 4,000 kw. output. This means that 500 kv.a. will be set free for sale and additional revenue and whether the prime movers are water, steam or gas driven the cost of the advancer installation will be earned in a comparatively short period.

The writer is indebted for the above information to The Canadian Crocker-Wheeler Company, who handle the Brown Boveri manufactures in Canada.

Artistic New Lighting in Old Theatre

The theatre-going public must be pleased not only with the performance but also with their physical comfort at the theatre they attend. Realizing this, the Pitt Theatre, of Pittsburg, recently remodelled the entire equipment and installed the latest improvements in lighting. The details are of interest as there is much theatre building going on now owing to the steadily increasing popularity of the moving pictures. Illumination for this class of work is special and there is a noteworthy lack of definite information on the subject available.

The following description of the Pitt will serve as an example of recent practice. The main ceiling has 3 Parian bowls, a 500 watt lamp in each, hanging 20 ft. from ceiling. In front of the second balcony are 14 8-in. Parian acorns, a 40 watt lamp in each. In front of the first balcony are 17 Parian panels with two 16 c.p. carbon linolite lamps and Frink reflector behind each panel. Ceiling over first balcony 4 Parian bowls, 250 watt lamp in each. Second floor corridor, 6 bowls, 150 watt lamp in each. First floor corridor, 5 bowls, 250 watt lamp in each.

Newel post at foot of stairs, Parian urns, 150 watt lamps in each. Under first balcony, 4 bowls, 250 watt lamp in each. First floor box, 8 bowls used as ceiling lights with three 25 watt round bulb tungsten lamps in each. Second floor boxes, 8 Parian acorns, suspended with arms so that they give the appearance of urns, 150 watt lamp in each. The height of main ceiling is about 40 feet. Floor space of main floor including corridor, 80 ft. x 100 ft. Floor space of first balcony about 35 ft. x 100 ft.

The color scheme of the theatre is blue and old ivory. The hangings, draperies, etc., are dark blue. All the glass work is decorated light blue and old ivory, with blue band—the fretwork on the Grecian band being brought out in blue. For the ladies' retiring room special bowls colored old rose to match the hangings were selected.

Electric Arc Welding in Machine Shops

The use of the electric arc as a source of heat for welding, cutting and melting metals is one of the oldest applications of electric power, yet is the one most recently developed to a commercially practical degree for general purposes. As long ago as 1786 experiments were made with the arc as a source of heat, by using battery current, and from that time until today there has been a more or less steady interest taken in the subject. In 1887 Benardos and Olszewski developed a practical method for using the heat of the arc commercially, using an electrode of carbon and drawing an arc between the work and the carbon. The arc was used as a flame and a bar of filling material melted into place for welding. The arc derived in this manner is also used for cutting, by melting the material, from the piece worked upon. In 1891 Slavianoff further improved the method or process by using a piece of the filling material as the electrode and melting it directly into place with the arc. This is the most universally applicable method of welding and is most used today.

Welding or cutting may be done with an arc from any source of direct or continuous current if means are provided for regulating the amount of current flowing, but experience shows that it is necessary to introduce certain refinements into the controlling system in order to insure satisfactory commercial results. It will be obvious that merely depositing metal with the arc will not necessarily be doing a good piece of work, so various means of controlling the arc have been devised. It is in the type of controlling apparatus supplied that most of the difference lies between the various outfits on the market today, and that apparatus offering the most protection for both welding machine and article welded is the best. It is not sufficient to have a limiting resistance, or even the addition of an automatic circuit breaker to open an overload, but it is also desirable to have means for limiting the flow of current on short circuits when establishing the arc. And, the more nearly automatic these devices are the better it will be for the work.

In order to weld or cut with the electric arc it has been found best to attach the positive side of the circuit to the article worked upon and the negative side to the electrode holder. This is due to the fact that the positive terminal or electrode of any arc attains a higher temperature than the negative, and since the article is larger than the electrode it will carry off the heat faster, so in order to fuse the article at the spot worked upon it is necessary to give it more heat. To draw an arc it is simply necessary to touch the electrode to the article, withdraw it instantly to a short distance and the current will cross the gap so long as it is not great enough to rupture the arc. By moving the electrode about over the surface to be welded the heat will be always available, because the arc will follow the electrode due to its passing from the article to the electrode. If it passed the other way it would be more erratic, and less effectual.

Two systems of arc welding are in commercial use today, each of them taking its name from the man who first developed it commercially. One of these is the Benardos system, and consists in using a carbon electrode and melting in a piece of filling material. This is also used for cutting. The other system is the Slavianoff method of using a piece of the filling metal as the electrode and melting it into place direct with the arc. The latter system is the one used for steel sheet and plate work and for steel castings, and the Benardos system is used for cast iron, copper, aluminium and large steel casting welding. Direct current at about 70 volts is used for both systems and a compound-wound generator driven by a motor gives much better voltage control than any other source of supply. Several manufacturers offer welding outfits, but the most satisfactory outfit is that one with the most complete control system and prospective purchasers should investigate all of the various systems before purchasing. Most makers use motor-generator sets, but one maker offers merely a set of iron grid resistances in spite of the very low efficiency of such a system for reducing the voltage to that required for welding. A barrel of water with two plates in would do as well and be cheaper.

Sheet steel as thin as 28 B.W.G. has been successfully welded by one manufacturer and articles of 20 gauge are in regular production. From this point there is no limit to how large an article may be in order to weld it successfully,—locomotive side frames, heavy steel shafting, frames of machine tools, boilers and practically every article of iron and steel has been welded. Brass is rather hard to weld successfully because the zinc volatilizes and passes off easily, but castings of medium and large size can be handled readily. Other alloys of copper may also be welded, as may also aluminium castings, copper sheets and other metals. Broadly speaking, the metallic electrode process is limited to articles of iron and steel, whereas, the graphite electrode process may be used for any metal, the only limitation being that the work must be in a horizontal position to prevent the molten metal running off the piece because that is largely a "puddling" process. When cutting it is necessary to give the metal a chance to flow, of course.

For welding iron castings it is desirable to pre-heat the piece in order to expand it in the proper direction and prevent cracking due to shrinkage when cooling, and also to insure welds that will be soft enough to machine afterwards. This latter point will also be better insured by re-heating the piece after welding and cooling as slowly as possible. A good flux is necessary for cast iron welding in order to raise the slag and insure a homogeneous weld. Other metals require no fluxes. There is apparently no limit to the articles which may be welded with the electric arc and such apparatus is being adopted rapidly by manufacturers in every line, steam and electric roads, marine repair companies and iron and steel foundries. Owing to the low cost of operation an outfit of this sort will, it is claimed, return its cost in a very few months if used in place of any other system of welding or joining metals.

Addition to Kaministiquia Power Plant

The Kaministiquia Power Company of Fort William, commenced a few weeks ago the addition of an extra unit of 12,000 horse-power capacity to their plant. This extra unit is almost double the capacity of any one of the three units totalling 22,000 h.p. that constitutes the present plant. The new addition to the Kaministiquia Power Company will cost approximately $1,000,000. The company have some 350 men working on the building of the new aqueduct at Kakabeka and have also let three contracts that gives employment to another 100 men. With the regular staff, construction gangs and contractors 500 men will be employed steadily for the remainder of this year.

Moose Jaw, Sask.

A new plan has been submitted to the light and power commission for the supply of electric power at a low rate, this power to be developed in the Estevan coal district. The proposition is understood to be to manufacture electric energy by gas-heated boilers the gas being a by-product in the manufacture of briquettes from the lignite coal.

Electric Railways

Electric Locomotive Design

By E. V. Pannell and W. K. Gratwicke

The rapidly increasing development of Canadian water powers, together with the widespread distribution of electrical energy, tend to the conclusion that the railways of the Dominion will sooner or later be operated to a considerable extent by electricity. In all other countries where fuel is dear and water power available the same result is being brought about; first the suburban and interurban lines and later the mountain and trunk line divisions being converted from steam to electrical operation. The fact of electrical railway work being pursued in so many different countries having different conditions and engineering standards makes a comparative study of the case a very interesting one and in the present article a comparison is made of some of the outstanding forms of motive power in use for train propulsion on electric railways. On two of the principal Canadian railroads electric locomotives will be running at no very distant date; a survey of the development of this class of machine is therefore of topical interest.

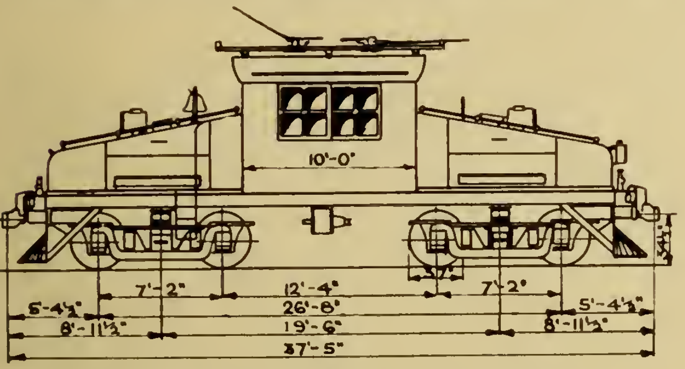


Fig. 1 Oregon Electric Railway Locomotive, Class A.

Although in the very early days of electric traction gearless locomotives were quite common they were largely superseded for general work by the type shown in Fig. 1. This represents a machine built by the General Electric Company for the Oregon Electric Railway and is of the well-known two-bogie type having a motor geared to each axle. This form of machine (which may be designated Class A) is too well-known to need detailed description; maximum adhesion, flexible wheelbase, and interchangeability of parts with motor-car equipments are its main features. Many hundreds of machines of the type shown are in operation in all parts of the world for all classes of service and the design has been adopted as a standard by practically every builder.

When the directors of the New York Central and Hudson River Railroad decided upon the electrification of their trunk lines out of New York City it was realized that a special type of electric locomotive was necessary. Not only was high running speed a prime requisite but for operation in a crowded terminal high acceleration was also essential. High speed postulated gearless motors, whilst high tractive effort required maximum adhesion. The solution of the problem was afforded by the Mohawk machine, especially designed by the General Electric Company for this service. In its original form it had leading and trailing pony trucks but the wheel arrangement was subsequently modified in accordance with Class B (Fig. 2). In general it may be said that for high speed service the four wheel leading truck has shown itself just as necessary in electric as in steam practice. The most interesting feature of the Mohawk locomotive is, of course, the motor system. The armatures are keyed to the axles and the bi-polar fields are bolted to the frames; this

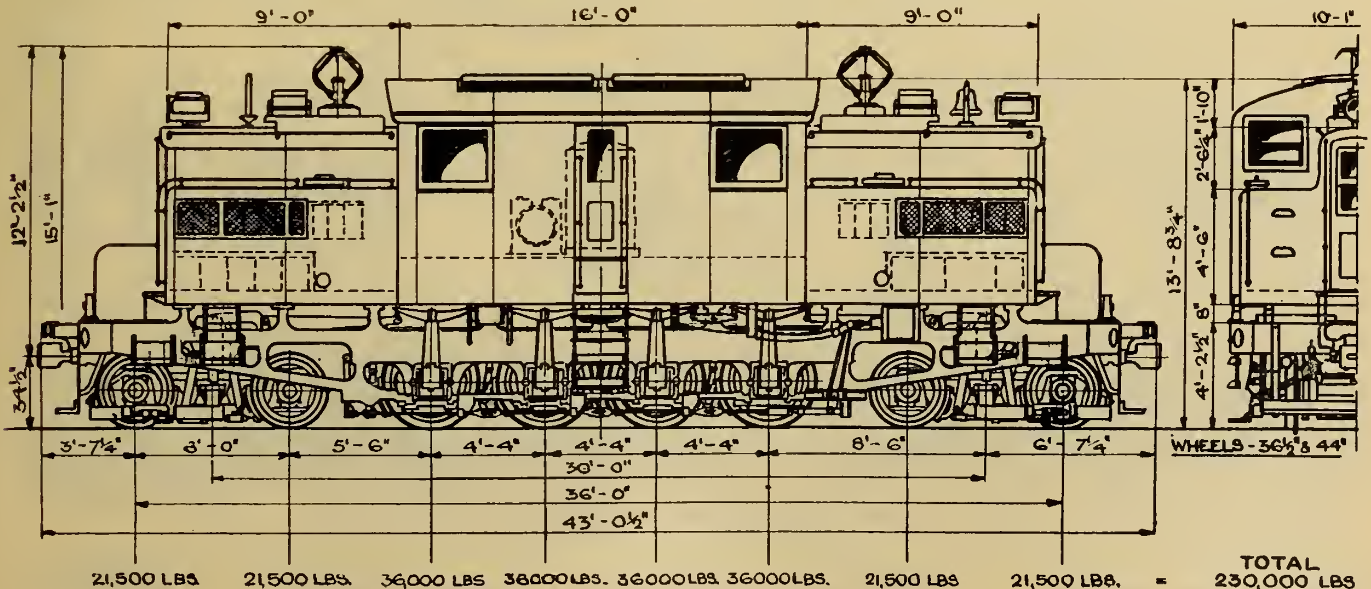


Fig. 2. New York Central Locomotive, Class B.

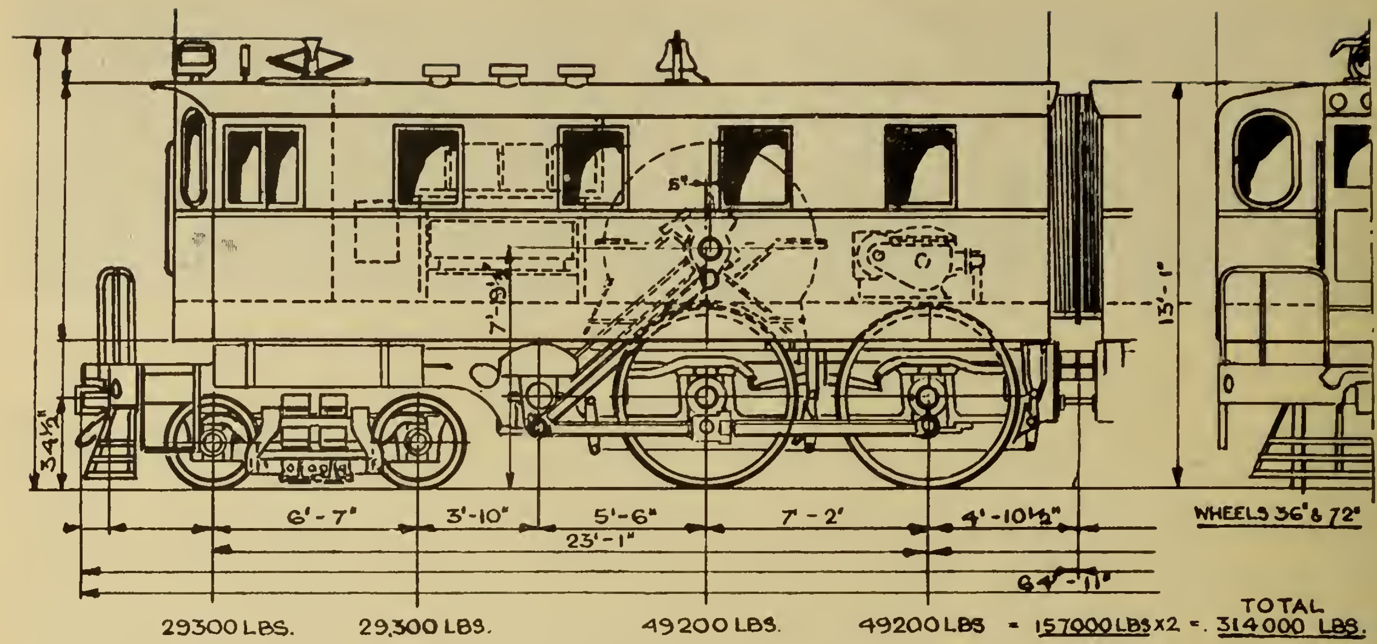


Fig. 3. Pennsylvania R.R. Locomotive (Half-Unit,) Class C.

permits of vertical motion of the axles and relieves the axle of all dead load except that of the armature.

After the introduction of the New York Central machines in 1907 many interesting forms of gearless locomotive were designed. Several of these appeared upon the New Haven Railroad and will be described later. At this time it was argued, particularly by European engineers, that a high center of gravity conduced to steadier running of the locomotive and to a great extent eliminated nosing and vibration. The natural deduction was that the proper place for the motor was above the frames driving the wheels through side rods and cranks. This permitted the employment of large motors of substantial design and ample ventilation and driving wheels of 60 to 70 in. diameter. After experimenting with two machines of the articulated type the Pennsylvania adopted the side rod engine for the operation of their Hudson River tunnel in New York and one-half of their complete locomotive unit is shown at Fig. 3 (Class C). It is interesting to compare this with the Class B locomotive last described; both are of about 2,000 h.p. on the one-hour rating and both have the same number of driving and idle wheels. Class C is, however, 50 per cent. heavier and has a 50 per cent. longer wheelbase. Nevertheless, published reports go to show that the Class C locomotive has performed excellent work and a large number are in use by the above mentioned railroad for their tunnel service. The opinion of railway engineers is, however, becoming opposed to the electrical side-rod machine, and it is not likely that any further examples will be built in America. The heavy unbalanced moments produced by the conversion of the rotary motion to a thrust and back to a rotary motion again are a source of trouble and demand such fine adjustment of bearings and journals that this type of machine lacks the rugged characteristics of either the Mohawk or the geared locomotive.

On the New York, New Haven & Hartford a very interesting series of locomotives has been developed, of which a gearless and geared form are illustrated respectively in Figs. 5 and 6 (Classes D and E). The gearless machine, which was first introduced in 1907, departs from New York Central practice in that the armatures are not keyed to the

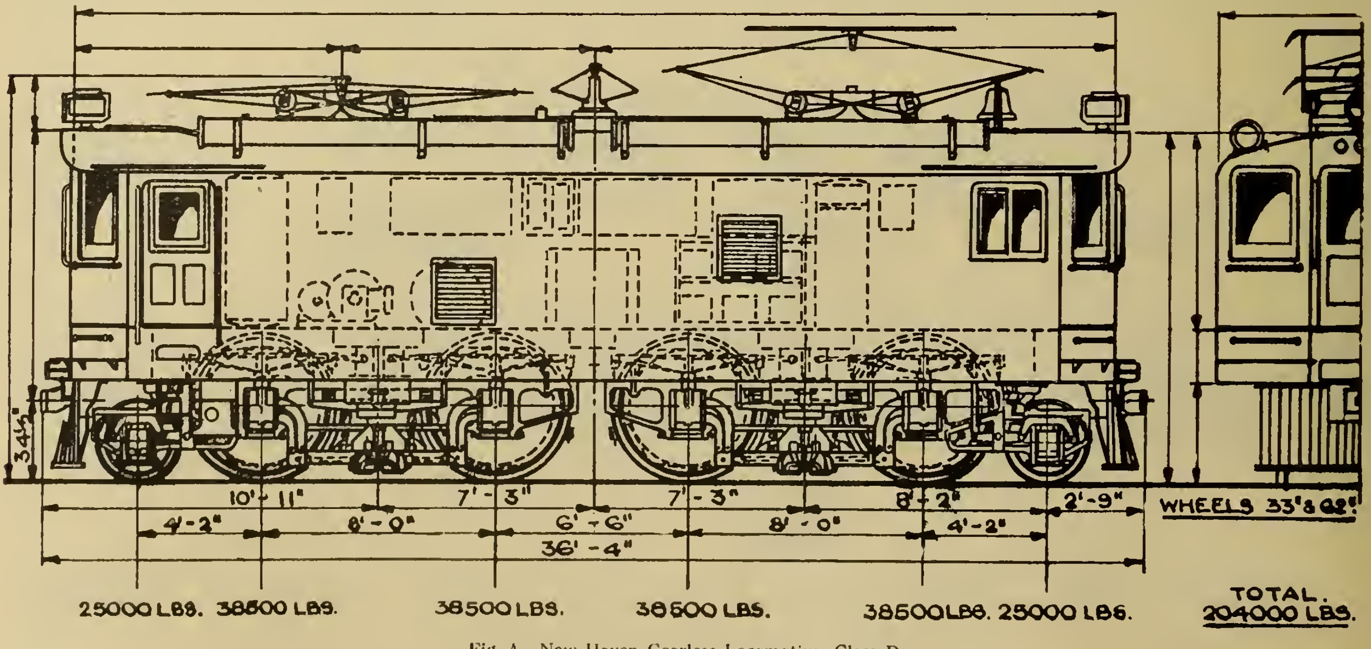


Fig. 4. New Haven Gearless Locomotive, Class D.

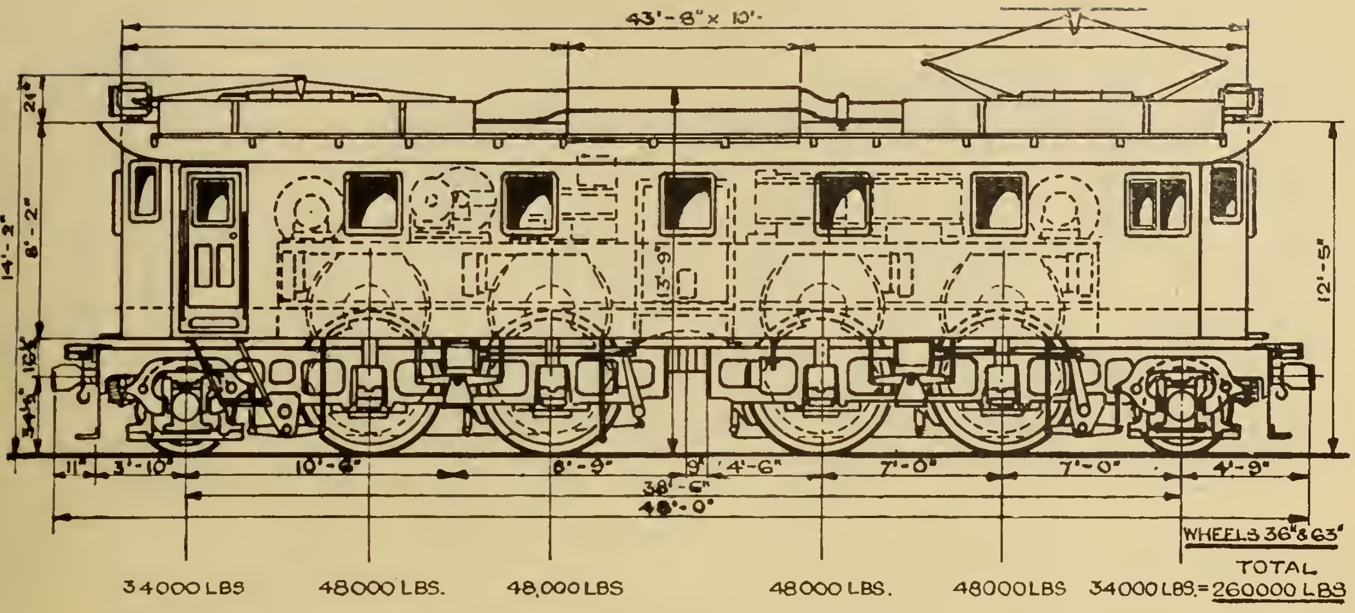


Fig. 5. New Haven Geared Locomotive, Class E.

axles but to quills which float around the axles and are separately sprung on their own bearings. The drive is by a spring claw engaging in pockets on the inner side of the wheel at either end. By this means the whole motor is spring supported, whilst at the same time the advantages of a concentric drive are obtained. Type D was first put upon the road as an eight-wheeler without the leading and trailing wheels, but the usual nosing trouble appeared to render a twelve-ton leading truck a vital necessity.

For a given class of service, provided that armature speeds do not exceed judicious limits, geared motors are preferable to gearless on account of lower cost; if therefore a gearless machine can be superseded by a geared one having exactly the same characteristics the latter will be a cheaper machine. In general, however, unless the gear ratio is very low, it will be better adapted to freight than to passenger service. Class E (Fig. 5) represents a further development of the New Haven design and is practically identical with the last mentioned save for the use of geared motors. The gear wheel is now keyed to the quill and the motor bears upon and is vertically above the quill and axle. Owing to the maximum torque of the motor reaching a value of 11,000 lbs. it was found necessary to design with a shorter motor axis and to use two gears, one at each end of the shaft to avoid twisting of the motor shaft or the quill. Besides the examples of Class E operating on the New Haven Railroad this pattern has been duplicated for service on the Hoosac Tunnel Division of the Boston & Maine Railroad.

The third outstanding design in use on the New Haven Road is Class F or the Colonial type shown in Fig. 6. Briefly, this is Class E modified to employ eight small motors instead of four large ones. In this case as each gear wheel has to transmit the torque of only one 170 horse power motor through any one tooth it suffices to use a single gear. By this means the motor can be designed with a greater axial length and so is a more compact and better ventilated machine. A further advantage is that the small armatures and other details are interchangeable with the similar parts on motor-car equipment so that a relatively small number of spares is called for. These features have combined to render the Colonial type one of the most useful locomotives in use on the New Haven Railroad. It should be mentioned that the interesting trilogy of designs, Classes D, E and F, are all due to the Westinghouse Company of Pittsburgh.

The Class A locomotive already described was considerably limited in its scope owing to the fact that it was mounted on two bogie trucks of the ordinary motor-car type; the drive therefore had to pass through the king-pin of each

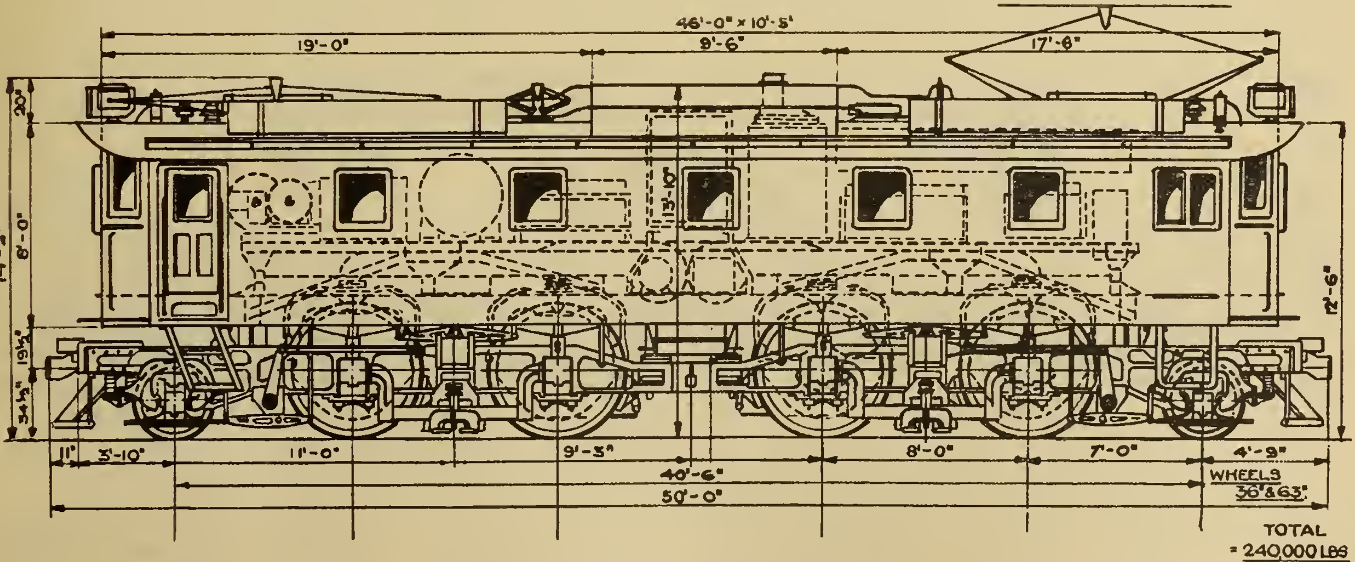


Fig. 6. New Haven "Colonial" Locomotive Class F.

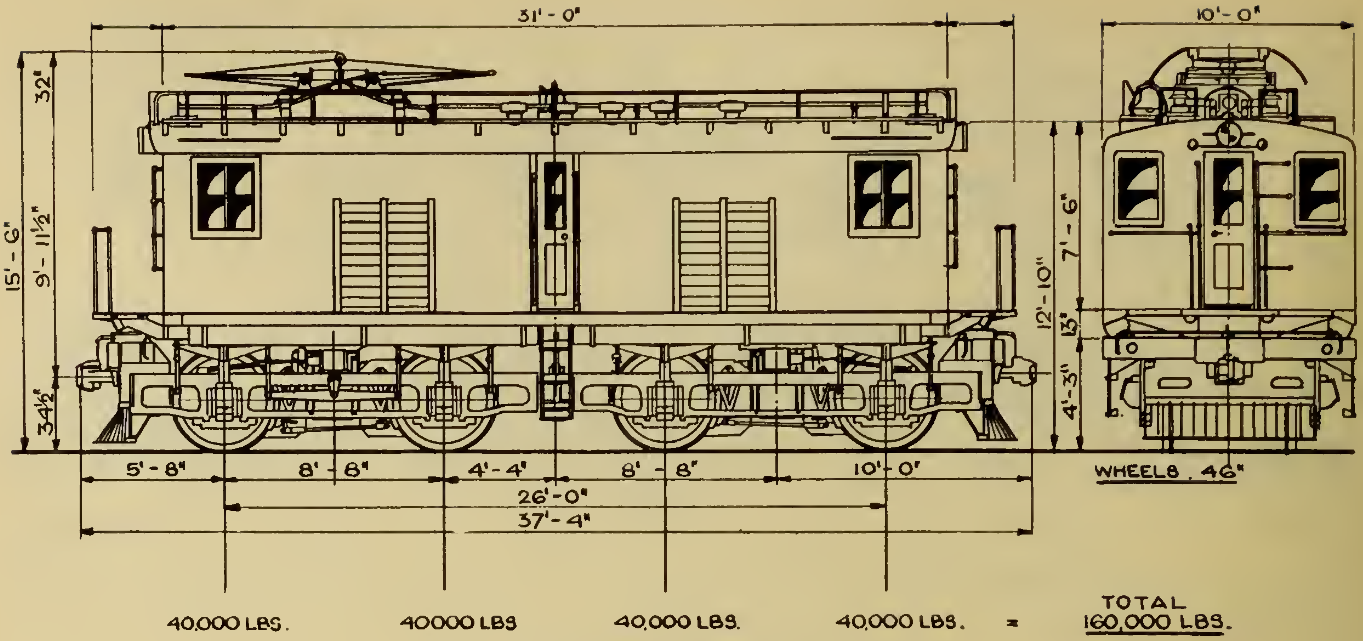


Fig. 7. Butte Anaconda and Pacific Locomotive, Class G.

truck. With the introduction of the articulated machine, however, the trucks take both the drive and the pull, and are independent of the body of the locomotive. At the same time it is possible to employ larger motors and wheels with this type of machine. Fig. 7 illustrates this type (Class G) and it is interesting to note that the machines being built for the Canadian Northern service in the Montreal tunnel are practically identical with that shown in the figure. As will be observed the trucks are linked together and themselves form a complete locomotive, the cab being merely a housing. The motors are geared in the usual manner but owing to the exceptionally heavy torque to be transmitted the gearing is necessarily of very heavy design and in some instances double gearing has had to be employed in this form of machine. (This applies to the locomotives working on the Detroit River Tunnel and the Baltimore Belt). It has been confidently predicted by experts that the Class G locomotive represents the last word of design for extra heavy passenger, freight and terminal service.

The last machine to be described is that shown in Fig. 8 and is a development of the Mohawk type Class B. The colloquial name applied to the Class H locomotive is the "Caterpillar," and this well represents the flexible characteristics of the machine. The complete wheelbase is utilized for adhesion and four articulated trucks are used each being equipped with two motors of the design employed in Class B. The weight and horse power are almost the same as in the case of the machine last referred to, but the tendency to use a large number of small motors instead of fewer large ones is followed. The Class H locomotives have been tested out at high speeds and found to give extremely steady running.

Some of the main particulars of the locomotives described are included in the table which follows. In dividing locomotive designs into eight main types it is not intended to imply that these exhaust all the practical designs, but merely that they represent a series of distinctive machines, and indicate to some extent an evolutionary progress.

The electric railway being built by the Lacombe & Blindman Valley Railway Company will be completed from Lacombe as far as Gull Lake by July 1. It is expected that the first gasoline electric car will be ready to operate this part of the line by that date.

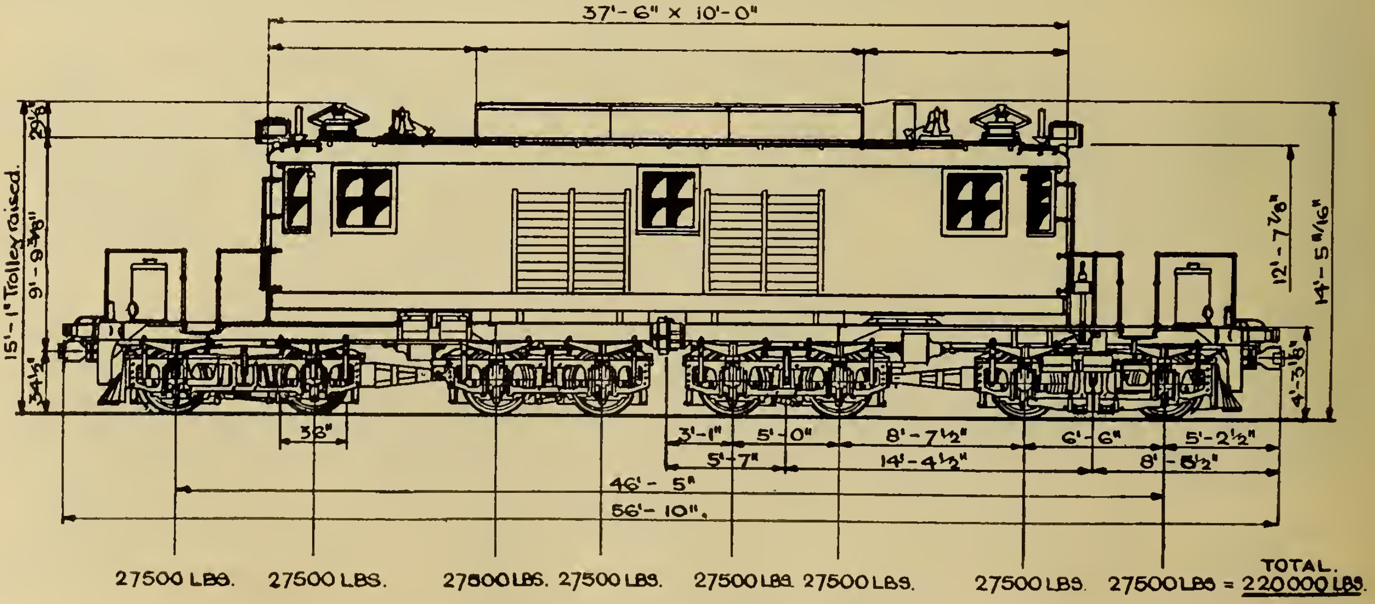


Fig. 8. New York Central Locomotive, Class H.

TABULATED DATA OF ELECTRIC LOCOMOTIVES (See article by Pannell & Gratwicke)

CLASS	A	B	C	D	E	F	G	H
Makers	G.E. Co.	G.E. Co.	Westinghouse	Westinghouse	Westinghouse	Westinghouse	G.E. Co.	G.E. Co.
Railroad	Oregon Elec.	N.Y.C.	Penna. R.R.	New Haven R.R.	New Haven R.R.	New Haven R.R.	Butte Anaconda	N.Y.C.
Wheel Arrangement	4-4 Bogie Trucks	4-8-4 Rigid Frame	4-4, 4-4 Coupled Units	2-4, 4-2 Articulated Trucks	2-4, 4-2 Articulated Trucks	2-4, 4-2 Articulated Trucks	4-4 Articulated Trucks	4-4, 4-4 Articulated Frame
Drive	Gear	Direct	Side Rod	Quill	Geared-Quill	Gear	Duplex-Gear	Direct
Weight, Lbs., Total	100,000	230,000	332,000	204,000	280,000	220,000	160,000	200,000
Weight, Adhesive	100,000	144,000	197,000	154,000	192,000	182,000	160,000	200,000
Tractive Effort, Max.	25,000	47,000	60,000	19,200	40,000	45,500	48,000	13,500
Tractive Effort, as 20% Adh. Wt	20,000	28,800	39,400	30,800	38,400	36,400	32,000	40,000
No. Motors	4	4	2	4	4	8	4	8
H. P. Each; 1 Hr.	100	550	1000	250	315	170	225	250
H.P. per Ton Wt.	8	19	12	10	9	12	11	20

Electric Railways and Letter Carriers

By the terms of an amendment to the Canadian Post Office Act passed by the House of Commons on May 4th and by the Senate on June 4th, the Postmaster General is given power to fix the rate at which an electric railway company operating in Canada shall carry a letter carrier on the street cars.

As the amended bill passed the House of Commons, Hon. L. P. Pelletier, Postmaster General, was given authority to fix whatever rate he deemed sufficient and any company who did not approve of his terms could not obtain redress. The Senate, however, altered the amendment as endorsed by the House of Commons and gave the right to a company to appeal to the Railway Commission for redress in the event of a dispute arising.

Clauses 8 and 9 in the amended act which applied to the rate at which an electric railway company should carry a letter carrier, as passed by the House of Commons read as follows:

8. Letter carriers in the service of the Post Office Department shall be conveyed on every electric railway in Canada, except municipally owned electric railways, on such terms and conditions and under such regulations as are made by the Postmaster General.

9. If any company operating such electric railway refuses to carry any such letter carrier at the amount so fixed by the Postmaster General, the company shall refund an amount equal to the difference between the amount so fixed and the amount actually expended for such carriage.

Clause 9 as above was struck out by the Senate and the following substituted:—

"And in the event of a dispute between the electric railways or any of them and the Department, the terms and conditions shall be fixed by the Board of Railway Commissioners for Canada, and in so doing due regard shall be had by the Board to terms and conditions agreed upon heretofore between the said electric railways and any of them and the Department."

During the discussion on the amendments on May 4th Mr. J. M. Douglas, M.P., objected to municipally owned railways being made an exception. In reply Mr. Pelletier said that in the experience of the Post Office Department there had been no trouble with municipally owned roads over the fixing of rates for the carrying of letter carriers. Continuing he said in part: "I have put this section in in order to show to other companies with which we have been having so much trouble—companies which are making enormous profits and which have no consideration for employees who are obliged to walk the streets with their loads—to show them that we intend to make a distinction between them and those companies which offer us fair terms. I want to make a clear distinction between the people who act in a fair way in the matter and those who demand from us prohibitive rates and if they do not get them decline to take care of the transportation of the men."

The Ontario Railway Board have made a recommendation regarding expenditures by the Toronto Railway Company. This expenditure requires the relaying of some 13½ miles of single track and the addition of 30 cars to provide sufficient accommodation for rush-hour traffic. The re-routing of a number of car lines is also recommended.

New Books

Telephone Construction, Installation, Wiring, Operation & Maintenance, by W. H. Radcliffe, E. E., and H. C. Cushing, Jr., E. E.; Norman W. Hanley Publishing Company, New York, publishers; price $1.00. This is a treatise describing and illustrating up-to-date methods of telephone practice, including the principles of construction and operation of telephone instruments; approved methods of installing and wiring them; the means of protecting them from lightning and abnormal currents; their connection together for operation as series or bridging stations; and rules for their inspection, repair and maintenance. Line wiring, and the wiring and operation of special telephone systems, as well as a complete explanation of automatic telephone exchanges are given. Intended for electricians, wiremen, engineers, contractors, architects, and all others interested in standard telephone practice. The reader is assumed to know absolutely nothing of telephony and no intricate mathematics are used nor is mention made of any apparatus, circuits or systems which are not thoroughly illustrated and described with respect to their construction, installation, wiring, operation and maintenance.

Electric Motors—B. Crocker, E. M., Ph.D., and Morton Arendt, E. E.; D. Van Nostrand Company, New York, publishers. price $2.50 net. This is a second edition of a treatise published in 1910 and contains many amendments and additions to make the subject clearer and more complete. Some sections have been considerably revised and enlarged as. for example, "starting box calculations for direct current, shunt and alternating current induction motors," and an entire chapter on the power requirements of various tools, etc., has been introduced. As set forth in the preface to the first edition the object of the authors has been to explain the operation of the various types of electric motor with sufficient clearness for most operators. Though the matter necessarily contains much that is technical, particular care has been taken in omitting descriptions which have no particular practical application. In the words of the authors the volume has been kept strictly within the limits of a handbook no attempt being made to produce an encyclopedia of the whole subject or an exhaustive treatment of any particular branch. The book contains 300 pages and is well illustrated and well printed.

Illumination

Street Lighting Units for Nitrogen Lamps

With the introduction of the nitrogen lamp it is apparent that an entirely new line of suitable fixtures for same becomes a necessity. The nitrogen lamp fixture must be well ventilated and must be adapted for use with a variety of shapes and styles of lamps, and in the case of street lighting units it should also be capable of service on either series or multiple circuits with a minimum of structural changes. The firm of A. H. Winter Joyner, Limited, who have for a number of years made a special study of street lighting equipment, are now placing on the market a very complete system of fixtures, designed primarily for utilizing nitrogen lamps in the class of service in which they specialize. A few of these are illustrated herewith.

Two general types of fixtures have been developed, i.e., the pendant type, Fig. 1, and the patented pole top type, Figs. 2, 3, and 4. Both types are made in two sizes, the larger in each case being adapted specially for nitrogen units of 300 to 1,000 watts, both series and multiple, and are particularly serviceable for the "White Way" illumination of commercial and other important thoroughfares. The smaller size of each kind is more adapted for the lower power series nitrogen lamps, and for tungsten units from 100 watts to 250 watts. The smaller pendant type can also be used to good advantage in industrial, shop and other general work.

The more general form of the pendant type is shown in Fig. 1. The body consists of the best grey cast iron, accurately moulded, and so made that anyone can quickly adapt the unit to any size of lamp or from series to mulsired, or a combination globe and reflector apron can be sired, or a combination glob and reflector apron can be fitted. This unit presents an excellent appearance when mounted on a wrought iron bracket or with wire suspension fittings. The exterior is usually finished in black baked enamel, but can also be supplied with any bronze or other ornate finish desired.

Owing to the fact that a pole with a lighting unit mounted directly on top lends itself to most artistic treatment, a very strong reason for developing the pole top type of nitrogen unit is evident; especially when, as is the case, the excellent appearance can be effected without sacrificing any of the good illuminating qualities of the fixture. Fig. 4 shows a good design of this kind.

The nitrogen lamp, owing to its peculiar characteristics, must be burned tip downwards, and probably will always require to be so operated. At least it seems necessary that an ample cavity be left in the upper part of the bulb for the reception of deposits. This being so, the pole top type is well adapted to take care of this need as will be seen by reference to the illustrations. To make the appearance satisfactory, it seems desirable to have a metal hood or canopy above the globe, and in this the lamp socket can be placed.

There is, however, one difficulty which presents itself when the socket is so located that at first sight appears a great objection, but, with the design adopted, is claimed to be most effectively overcome. In order to get at the interior of the fixture for cleaning the globe or replacing the lamp, the leads to the socket in the canopy must either be left slack and untidy, or else must be capable of automatic disconnection. A reference to Fig. 3 indicates that a very simple solution of this has been made. The canopy is supported on a spiral tubular stem which also carries the leads, and the stem is attached to a cast tripod at the lower end. To this latter is also attached a male plug carrying suitable electrical connections, and insulated and made mechanically strong with

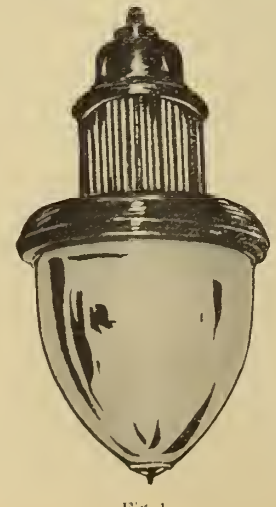


Fig. 1

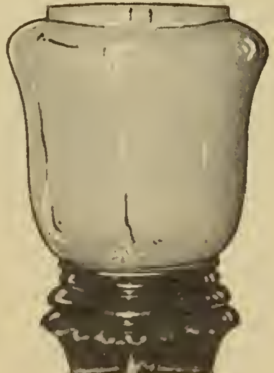


Fig 2.

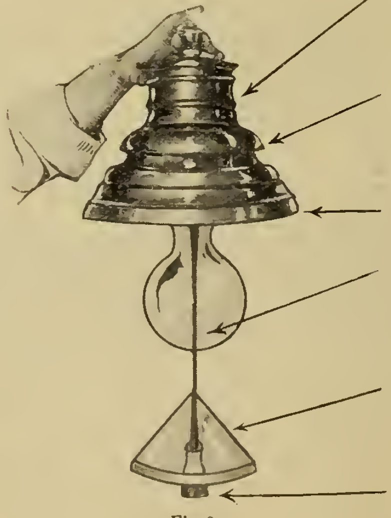


Fig. 3

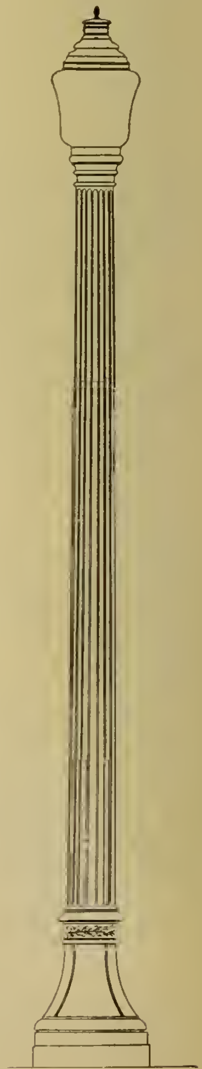


Fig. 4

moulded bakelite. This plug screws into a second mogul socket base centrally located near the bottom of the globe, and the tripod itself rests at its outer edge on a specially designed ring forming part of the top section of the pole. Assuming that the fixture is in position it will be seen that it is only necessary to unscrew the mogul plug by rotating the entire piece illustrated in Fig. 3 for a few turns, in order to withdraw the same from the globe. When separated the lamp can be replaced and the globe cleaned or renewed.

It will be noticed that should the outer globe break, the rest of the unit will remain in position and the light will continue to burn without any other harm being done.

The leads in the detachable section are unaffected by heat and are neatly and permanently connected from the upper socket to the lower plug. All connections are sweated in.

The single steel support was adopted because it could be made as rigid as a more complex design and it was thought better to have one shadow on the house side of the globe than three somewhat smaller ones equally spaced. The stem is, however, carefully flattened along the lamp radial to reduce the shadow formed by it to a minimum and the shadow is only of penumbral formation.

The illuminating characteristics of this unit have been most carefully worked out. Not only is the glassware of special composition, suitable for notrogen lamps, giving a maximum of efficiency and diffusion, but it is specially designed for good distribution. The unit is also fitted with two reflectors, one above and one below the filament, the latter also serving as a neat cover for the lower connections and tripod. These reflectors are so designed to produce practically a uniformly lighted globe, free from shadows and with well directed rays of street illumination.

From the foregoing description it will be appreciated that much careful thought has been expended on these units and the product is in every sense the result of much practical experience with the new lamps and in street lighting problems. Already large installations are being made for lighting the streets of Windsor, Ont., and Outremont, Que.

Restaurant Lighting

Illumination is coming to be recognized more and more as an exact science and what every architect formerly did for himself is now being delegated to specialists in lighting just as important problems in other branches have for many years been worked out by specialists in their respective lines.

As an example of efficient illumination the two photographs reproduced herewith indicate the progress that is being made in one of the many branches of industrial illumination, namely restaurant lighting. Too often our restaurants are lighted according to the fancy of a more or less whimsical landlord with no reference to the requirements of the installation. This is one case, however, where it is good business to have an attractive and at the same time soothing and artistic effect and there is no place where an efficient engineer could be called in to better advantage.

Of the illustrations Fig. 1 is a good example of cove lighting as installed in the Bellevue-Stratford Hotel, Philadelphia. Illumination is by the indirect system and the type of illuminant used is the Linolite. The indirect lighting is supplemented, for effect, by direct lighting from candelabras shown on the tall uprights; the brilliancy of these latter lights is toned down by means of soft brown silk shades. These latter are used partly to relieve the impression of coldness which is sometimes felt in indirect lighting and partly to give restfulness and pleasure to the eye by the soft color effect. Fig. 2 is a photograph of the Cafe Parisian of the Ritz-Carlton Hotel, Philadelphia.

These examples of excellent illumination indicate in a very fair way the stage we have reached in the development of better illumination systems and show that in the majority of cases no single system, either direct, indirect or semi-indirect can be arbitrarly employed if efficiency in all its phases is to be considered. A judicious combination of the various systems must be used, the particular installation determining which of the three shall predominate.

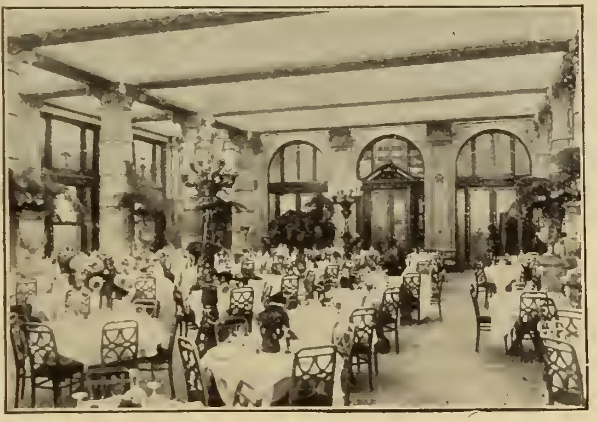


Fig. 1

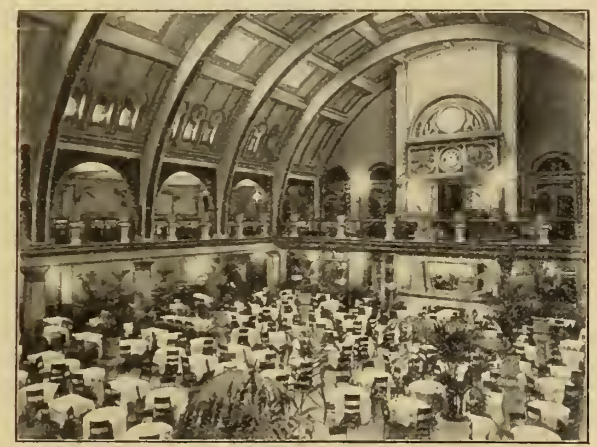


Fig. 2

The installations illustrated herewith were made by the H. W. Johns-Manville Company.

A flat rate of $6 from June 1 to September 7 has been given the summer cottagers at Port Stanley. This service is supplied from the St. Thomas municipal system.

New Companies

The Canadian Hart Accumulator Company, Limited, St. Johns, P.Q., has been incorporated with capital £60,000.

The Import Company, Limited, Toronto, has been incorporated with capital $40,000 to carry on an electrical business.

The Arundel Development Company, Limited, has been incorporated with capital $49,000 and head office Arundel, Que.

The Monarch Refillable Fuse Company, Limited, has been granted a charter with head office Hamilton and capital $40,000.

The Levvy Electrical Company, Limited, has been granted a charter to manufacture and sell electrical appliances; head office Winnipeg; capital $40,000.

The Dealer and Contractor

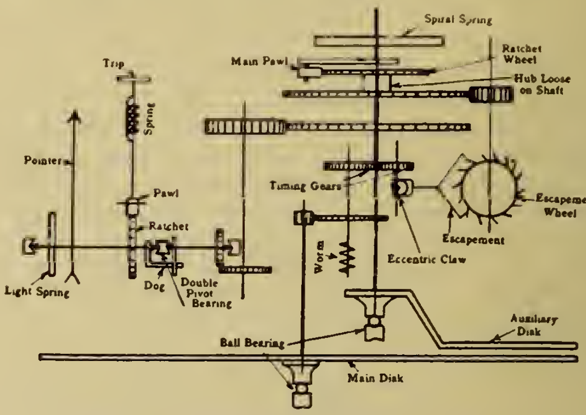
Watthour Demand Meters

For many years electric energy has been sold altogether at a rate of so many cents for kilowatt hour used, the rate depending only on the quantity. Recent years, however, have seen a very decided change in this method of selling and other factors are now given due consideration. The most important of these is the maximum amount of energy called for. There has, therefore, arisen a need for a watt-hour meter to measure this value. A new type of this meter has been recently placed on the market by the Westinghouse Company. This is a single meter that records without the use of a clock mechanism both the kilowatt-hours consumed and the maximum kilowatt demand.

This meter is a combination of an induction watthour meter, an induction wattmeter, and an escapement form of time element. The instrument has a standard Westinghouse type OA watthour meter movement, including electromagnet, permanent magnet and aluminium disk. In addition, it has an auxiliary disk sector supported on a jewel-and-ball bearing so that it can move in the air-gap of the electromagnet, in such a way that it does not interfere with the accuracy of the main disk which always rotates at a speed proportional to the load. The rotation of the auxiliary disk is restrained by a spiral spring, making its final deflection proportional to the watts load. The auxiliary disk with its spring and pointer constitute an indicating watt-meter.

The shaft of the auxiliary disk is geared to an escapement wheel, and the claw restricting this wheel is oscillated by an eccentric on the main shaft. The auxiliary disk therefore advances step by step at a speed determined by the speed of the main watthour meter disk, that is, at a speed proportional to the load. It continues to advance until the spring tension balances the torque produced in the auxiliary disk. The demand mechanism is then in equilibrium and the pointer indicates the watts.

As the total deflection and the rate of deflection of the auxiliary disk vary in direct proportion, the time required to reach the maximum position when any constant load is passed through the instrument is a constant. For example, if a load of 500 watts is applied to a 5-ampere, 100-volt meter with 15-minute time element, the demand mechanism will reach equilibrium at the 500-watt point in 15 minutes. If instead a load of 1,000 watts is applied to the water, the demand mechanism will have to move twice as far, to the 1000-watt point, to reach equilibrium; but the double load will move the watthour disk twice as fast, causing the escapement to allow the demand disk to move twice as fast, and it will cover the double arc in the same time.



Schematic diagram of meter without dial mechanism.

A mathematical analysis of the instrument shows that the deflection for any varying load that does not continue long enough for the instrument to reach equilibrium is equal to the average load during the interval.

The auxiliary disk drives the demand pointer through a dog, and a fine-toothed ratchet and pawl holds the demand pointer in the position of maximum deflection, until released by hand. A second ratchet and pawl allows the auxiliary disk to fall back to equilibrium under its spring tension if the load falls below that corresponding to its position at any moment, but prevents it from advancing except as controlled by the escapement as before.

The maximum demand pointer can be reset instantly by pressing a sealed button on top of the cover. This raises the pawl that holds the pointer in its maximum position and a light spring returns the pointer to zero, or to the position of the auxiliary disk.

The annual report for the year ending March 31, 1914, of the Westinghouse Electric & Manufacturing Company shows gross earnings of $43,733,646. This is a gain of nearly $4,000,000 over the previous year and is the largest on record.

Arrangements are being made for a rejuvenation of the Sons of Jove during the convention of the Canadian Electrical Association, in Montreal.

The "Century" Motor

The popularity of the Century motor is well illustrated in the number of sales made by the Jones & Moore Company, Toronto, during the first ten days of June. These sales totalled between 30 and 40 machines in horse-powers varying from ⅛ up. Jones and Moore advise that they are also doing an excellent business in other lines. Their sales of the last week include a generating set for a moving picture theatre, a rotary converter and a number of large A.C. motors as well as a quantity of d.c. equipment in both motors and generators. The purchasers include such well-known names as the Toronto Railway Company, the Gurney Foundry Company, the Zimmer Vacuum Company, the Canadian Buffalo Forge Company, the Elliott Woodworker Company, the Hydro-electric Power Commission of Ontario, the Toronto & York Radial Railway Company, the Toronto Hydro-electric System, the Fletcher Manufacturing Company, etc.

Speed Regulators for Slip Ring Induction Motors

The Allen-Bradley Company of Milwaukee, Wisconsin, has recently developed a speed regulator for slip-ring motors which, it is claimed, has decided advantages over the ordinary wire wound or grid type resistance regulators on the market. The latter machines are generally rated to give a maximum speed reduction of the motor at full load of 50 per cent.; that is, on the first contact on the face plate of the register, the speed of the motor is cut down one-half. Now, assuming that the operating lever was left on the first contact and the load on the above motor reduced to one-half of what it formerly was, it would then only be possible to reduce the speed of the motor 25 per cent., since the speed variation of a slip-ring motor is dependent upon the load of the same and the limited number of contacts might not permit of a sufficient speed reduction. The apparent shortcomings of the old form of regulator are claimed to have been entirely overcome by the Allen-Bradley Carbon Compression type speed regulating devices. This is made possible by the fact that a resistance range of 100 to 1 can be obtained by means of the carbon compression resister and, therefore, the regulator can always be adjusted by turning the hand wheel to give the desired speed reductions. Of course, this could also be accomplished with the wire-wound or grid type resistance regulator, if the number of contacts and corresponding speed steps were greatly increased; however, the complexity, bulkiness and cost of such a device makes the same prohibitive for general use.

The cut herewith illustrates the simplicity and compactness of the Allen-Bradley regulator. The resistance and corresponding speed variation is obtained by turning the hand wheel which gradually compresses the carbon discs contained in the steel tubes, which are thoroughly insulated from the same. One of such resistance units is supplied for each phase. The applied pressure is absolutely equalized by means of proper mechanism so that the phases are never unbalanced. Another point of advantage claimed over the old wire-wound or grid type resistance is the fact that the resister employed is practically indestructible. It cannot burn out nor is it affected by the action of moisture or corrosive fumes.

Instead of obtaining only as many speed variations as there are contacts on the face plate of the regulator, it is possible to obtain an infinite number of steps with the carbon pile resistance, which is a feature of importance. Any slight turn of the hand wheel effects a change in the speed of the motor, so that the same may be adjusted entirely to operating conditions and held at this point. This method of control also does away with button contacts or renewable segments and consequently all arcing in moving the operating lever from one contact to another is eliminated. This speed regulator is very compact in design and light in weight, although it has a large overload capacity. For 50 per cent. speed reduction it is made in sizes up to 10 h.p. for fan and similar duty, while up to the present time 5 h.p. is as high as these machines are rated for machine duty.

Disc-Stove Chafing-Dish Set

A novel arrangement of a combination disc stove and chafing dish has recently made its appearance. The set is similar to the ordinary alcohol type chafing dish except that it has an electric disc stove, in direct contact with the water pan, instead of an alcohol heater. The complete set consists of a stand, a disc stove, cord, three-heat switch, and attachment plug, a water pan, a food pan, and a cover, as illustrated in Fig. 2. The water pan, the food pan and the cover are the same as used in alcohol heated chafing dishes.

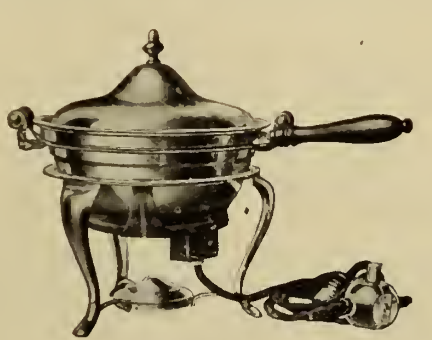


Fig. 1

The heater of the disc stove consists of a steel disc inside of which the heating element is sealed and protected from oxidation. A dead-air-space between the heater and the bottom of the stove casing acts as a heat insulator, preventing the loss of heat downwards, so that practically all of the heat is thrown upwards where it is wanted. This arrangement makes the stove very efficient.

An indicating switch controls the temperature. The high heat is ordinarily used to bring the chafing dish to the desired temperature. The low heat will keep water boiling after the boiling point is once reached and is useful for keeping food warm. The medium heat is the highest that is usually wanted for general cooking purposes.

With the feet of the disc stove reversed so that the stove can be suspended from the stand and with the parts assembled as in Fig. 1, the outfit is a chafing dish, capable of cooking anything in it that can be cooked in an alcohol chafing dish. Or, the food pan can be placed directly on the disc stove, omitting the water pan, and as such can be used for any cooking that requires high heat, such as frying, stewing, etc. With the feet inserted in the stove as shown

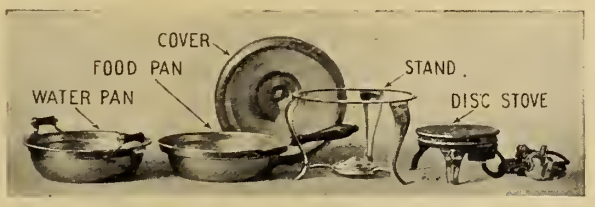


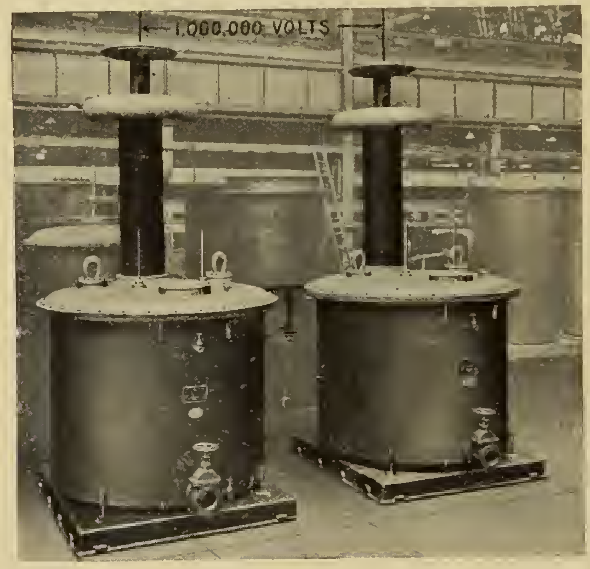
Fig. 2

in Fig. 2, the disc stove can be used separately, for any purpose that a single-burner gas stove can be used for, such as frying, grilling, making coffee, and similar operations. This set is manufactured by the Westinghouse Electric and Manufacturing Company.

Large Testing Transformers

The accompanying illustration shows two testing transformers, having a normal rating of 360,000 volts continuously, and 500,000 volts for short periods. These transformers were recently furnished the Inawashiro Hydro-Electric Power Company of Japan, one to be installed in the generating station on the Nippashi River at the outlet of Lake Inawashiro, about 145 miles from Tokio; the other in the receiving sub-station at Tokio, where they will be used for testing transmission lines and apparatus in the stations.

The design features of interest in these transformers are the arrangement of the windings to give distributed static fields; the use of condenser terminals to give distributed stresses from terminals to ground; and the terminal "hat" to distribute stresses from terminal tip to ground. The transformers are 19 feet high from base to top of terminal and the tanks are 9 feet high and 9 feet diameter. One high-tension terminal of each transformer is grounded to the core and case, the other being brought out as shown in the illustration. By connecting the cases of the two transformers as shown one million volts can be developed between the two high tension terminals.



These transformers were built by the Westinghouse Electric & Manufacturing Company.

The Mica Industry

One of the best known mica dealers in Canada is Mr. S. O. Fillion, of Ottawa. Mr. Fillion has been closely associated with the mica industry for the past fifteen years in Canada, the United States and in India, the three chief countries in which mica is produced. He spent four years, from 1905 to 1909, in the mica fields of Bengal and Madras and is considered one of the most expert dealers in the mica business. He founded his present business in 1909 and perhaps the best evidence of the service rendered has been the rapid growth of this business. In addition to his operations in Canadian Amber mica he has his own factory in Bengal whence his supplies of India Ruby mica are obtained direct from the mines and are specially prepared to suit the requirements of the trade in this country both in electrical mica and in stove mica. Hitherto it had been necessary for stove manufacturers to obtain their stove mica from United States dealers. Canadian manufacturers are now able to obtain through Mr. Fillion all qualities and grades in both Canadian Amber and India Ruby mica.

Interstate Electric Novelty Company of Canada

The Interstate Electric Novelty Company, Limited, of Canada, announce that they have opened an office, stock and show rooms in the Nicholls Building, 220 King Street West, Toronto. This Canadian company has acquired the sole rights for manufacturing and selling the well known Franco products of flash-lights, lamps and batteries and other electrical novelties. The parent company in the United States are just placing on the market some improvements in electric flash-lights in which the connections are so arranged that they are claimed to be absolutely unbreakable and not subject to short circuit. It is said that these flash-lights can be placed in the "kit" with the other tools without any danger of wearing out the battery.

B. S. Barnard & Co.

B. S. Barnard & Company, of 50 Church Street, New York, announce that they have recently taken on a new and improved line of conduit specialties such as tools for removing obstructions in ducts, conduit rods, wrappers, plugs, cable hangers, etc., as well as tools specially made of manganese steel. Mr. Barnard is generally known as the pioneer in underground conduit construction and though his company will still continue to be known particularly as the manufacturers of clay conduits, his experience should be a sufficient guarantee to the trade that in undertaking this side line the tools manufactured will represent the best in material and in labor economy that can be produced. Mr. Barnard's connection with the Clermont Sewer Pipe Company as vice-president for the last four years is almost as well known as the name Clermont itself, which is to be found on many millions of feet of conduit along the streets of the principal cities of Canada during the progress of installation of the last few years. Among the more prominent users may be mentioned the Bell Telephone Company of Canada who have placed their orders through Mr. Barnard for the past 15 years, the Montreal Light, Heat & Power Company, the Hydro-electric System of Toronto, the city of Hamilton, the corporation of the city of Westmount and many others. It is understood that Mr. Barnard has in mind a Canadian plant to manufacture a superior quality of clay conduits.

Though Premier Borden has intimated that there will be no government aid to Ontario's hydro- electric radial railway system this session the municipalities are still hopeful and will submit by-laws in the near future authorizing the construction of these railways conditional on a government grant being received.

Obituary

The Ferranti Electrical Company of Canada have suffered a severe loss in the death of their president, Mr. R. Bruce Anderson, who was a passenger on the ill-fated Empress of Ireland. Mr. Anderson was also very prominently connected with the British interests associated with the Canadian company, being managing director of Ferranti, Limited, and a director of the Bruce Peebles Company, as well as being chairman of the British Electrical and Allied Manufacturers' Association, and a member of the council of the Institution of Electrical Engineers.

The death occurred on May 27 of Sir Joseph Wilson Swan, the first Englishman to invent an incandescent lamp and probably the first in the world. This was in 1879.

Ozone Purifier

The illustration herewith shows a type of ozone air purifier made by the Neel-Armstrong Company, Akron, Ohio. This machine is being used successfully in moving picture theatres, toilet rooms of public buildings, etc.; also widely in refrigerators of abattoirs and meat markets where a saving in ice is claimed as well as an improvement in the refrigeration.

Tests by the city chemists of Akron in the Waldorf Moving Picture Theatre show the following results obtained by the installation of one of these machines:—

Examination of Air	Jan. 23rd 7 p.m. No Ozone	Jan. 24th 5 p.m. With Ozone	Reduction in Colonies of Bacteria
Carbon Dioxide, in parts per 10,000	35	30	—
Oxygen, per cent.	19.4	20.1	—
Colonies of bacteria on agar-culture plates:			
10 min. exposure .	300	17	95% reduction
20 min. exposure . .	innumerable	80	90% or more reduction

The outfit illustrated is equipped with a Robbins & Myers Rotary Transformer for converting direct current into alternating current for the transformer which steps the voltage up to the high pressures required for this service. A "Standard" fan also manufactured by The Robbins & Myers Company is mounted within the transformer case to blow the ozone out into the room.

Lightning Arrester Hangers

Special types of lightning arrester hangers have been placed on the market by the Electric Service Supplies Company for use in installing their Garton-Daniels lightning arresters. Heretofore operating men have made use of small cleats to fasten these arresters to the cross arms or have devised other means to meet unusual conditions. With careful consideration of the many varying conditions governing the installation of lightning arresters, these hangers were designed, (a) to furnish a hanger which would place them substantially, and (b) to make their installation easy.

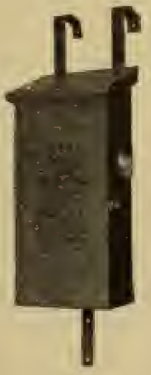


Fig. 1.

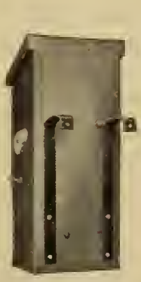


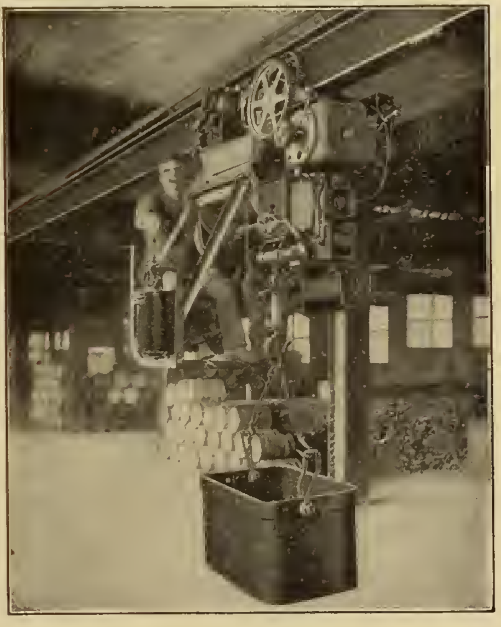
Fig. 2.

Style C hanger (Fig. 1) is for installations between two cross-arms; the upper part of the supports being bent to fit over the upper arm. It will be seen that it is a comparatively easy task to place the arrester when it can thus be secured to the cross-arms without having to be held. This is also true of Style B hanger (Fig. 2) but this style being for single arm installation does not require a lower support.

Electric Hoists

In order to satisfy the demand for efficient lifting and carrying devices to fill the gap between the handchain block and the large travelling crane, the Sprague Electric Works have designed a complete line of electric hoists in capacities from one-half to six tons. The motors and gears are entirely enclosed for protection against dust and moisture and the hoists can be used out of doors without any housing. They may be mounted on a plain hand geared or motor-driven trolley carriage as conditions require and the small I-beam track, which provides the best facilities for moving the loads, may be cheaply installed.

The variety of conditions under which these electric hoists can be profitably used is legion. For lifting small castings and forgings in a machine shop, to handle coal and ashes in boiler rooms, for carrying rolls of paper in a newspaper press room, the smaller styles are admirably adapted. The larger hoists are equally efficient for heavier loads. In transporting material in bulk some kind of carrier, crate, or bucket is necessary if it is desired to utilize the machine to the best advantage. The accompanying cut shows how a bucket can be carried on the hoist hook. Another successful application is in connection with the grab buckets for delivering coal and ore.



License Electrical Contractors

An ordinance has been passed by the city commissioners of Denver creating a board of electrical examiners. This board is to consist of three members, the city electrician being, ex-officio chairman. It will also include one electrical contractor and one journeyman electrician. These three men shall have the power and authority to examine every person engaged in the electrical business, whether employer or employee, helpers excepted. After the person passes the examination the board will issue a certificate of qualification upon the payment of 50 cents, and this certificate will be renewed yearly without examination.

A New Electric Range

A very attractive electric range is being placed on the market by the National Electric Heating Company, Toronto. These ranges will be manufactured in two models. Model A2 will have two 8-inch discs and a cooking oven in which there is also installed a broiler. This model is illustrated herewith. Each of the 8-inch discs draws 1,000 watts and the broiler and oven elements 1,000 watts each. All the elements have a three heat attachment—full, medium and low, the low consuming approximately one-quarter of the full heat. Model A4 will have two 8-inch discs and two 6-inch discs. The oven will be somewhat larger and both oven and broiler elements will draw 1,200 watts.

These ranges are very substantially constructed and impress one with the idea that they are made for everyday service. Construction is of heavy sheet polished plate steel thoroughly reinforced with angle iron frames. Nickel plated trimmings make a very attractive finish. The oven is aluminium lined, double seamed and the inner surface is of special insulating material impervious to gases. Both the body of the oven and the door are heavily insulated and the oven practically air-tight.

As shown in the illustration the elements are enclosed, which adds both to the efficiency and the life of these units. In practice it is found that the heat retaining properties of the units are such that the current may be turned off at least one-half of the time during cooking without delaying the operation in any degree whatever. Where a low heat is required for a considerable length of time the second or third heat is sufficient and equally economical. It will be noted also that the elements in the top of the stove are practically flush which enables the entire surface of the elements to be used for heating purposes. The oven unit is also installed flush in the same way.

A Large Crane

The photograph herewith is that of a 50-ton crane in the plant of the Canadian Light & Power Company. This crane has a span of 26 ft. 7 in.; a lifting capacity of 50 tons; a height of lift of 25 ft., and is of Northern Type "E" standard design, manufactured by the Northern Crane Works, Limited, Walkerville, Ont. The gearing is all steel with cut teeth; drum is grooved to take entire length of hoisting rope without overlapping and for a central plumb lift. The trolley is of their patented type "E" construction, having all hoisting gears enclosed, non-overhung, with bronze bearings, all bearings capped. Trolley travel gearing is of similar design. Crane is equipped with an automatic limit stop for stopping block at top of lift, also with both mechanical and electrical brakes and with bridge foot brake. Girders are of the box form of very heavy construction. Trucks are MCB type with capped bronze bearings of the waste pocket type. Block is of special construction to insure high life. Sheaves have bronze bearings. Hook is forged and annealed with the head resting on ball bearings and is arranged to both swing and turn. Crane is constructed to carry a full load of 50 tons, with a minimum safety factor of 5. Footwalk extends the entire length of bridge, allowing access to bearings on the trolley when in any position on the bridge. Truck and trolley wheels are of steel with machined treads. The construction of this crane adapts it especially to power station service. The enclosing of the gears insures the longest possible wear, durability, safety and the exclusion of all dirt and dust from the working parts and the most thorough lubrication. This construction also prevents the dripping of oil and grease from the crane over the machinery of the power station.

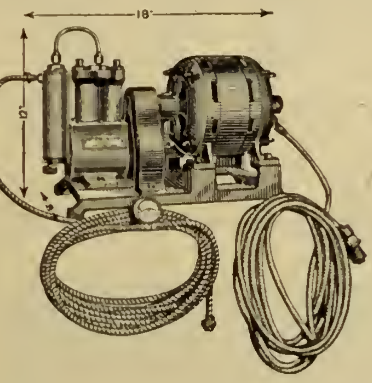
Series Nitrogen Street Lighting

One of the most interesting features of the electrical exhibits at the National Electric Light Association Convention was the new type Westinghouse nitrogen filled lamp which we understand has just been adopted by the sanitary district of Chicago for lighting the streets of the residential district of that city. The fixture when complete is similar in appearance to an arc lamp, each unit including an auto transformer. This transformer is designed to operate a 300 watt, 600 candle power, 20 ampere lamp from a 6.6 ampere or 10 ampere, 60 cycle constant current circuit. It is specially designed and arranged to protect a lamp from over voltage in case of line surges and severe grounds. This will be the first large installation of series nitrogen filled incandescents for street lighting purposes.

The Railway & Industrial Engineering Company, Pittsburgh, Pa., announce that they have moved their factory and main office to Greensburg, Pa., and that their manufacturing facilities have been materially increased.

An Electric Garage Pump

The Hartford Machine Screw Company have placed on the market an electric pump for private garages. The equipment consists of a two-cylinder pump driven by a small electric motor, all mounted on one frame. It is claimed this pump will completely inflate a 37 x 5 tire to 90 lbs. pressure in less than three minutes. The motor used is a small General Electric type. The equipment is illustrated herewith.



A New Elevator Motor

The Westinghouse Electric & Manufacturing Company has just announced that it is placing on the market an alternating-current squirrel-cage elevator motor of new design. The special features claimed for this motor are great mechanical strength, quiet operation, extreme reliability, and excellent performance characteristics. It requires only a simple switch without resistance and is started by being thrown directly on the line. It starts with high torque, so that the car is quickly but smoothly accelerated. Only a moderate starting current is drawn from the line.

These motors are made in sizes from 3 to 20 h.p., for 2 and 3 phase, 25 and 60 cycle circuits of 220, 440 and 550 volts.

The National Electric Heating Company, Limited, of Toronto, announce to the trade that Mr. F. C. Carman, late of the Canadian Carbon Company, Limited, is now on their sales staff. Mr. Carman will cover Western Canada.

Trade Publications

Strain Insulators—Folder issued by the Ohio Brass Company describing their new type X strain insulators.

Weather Proof Sockets—Folder issued by Pass & Seymour, Inc., describing the Shurlok weather proof socket.

Electric Hoists—Bulletin issued by the Canadian General Electric Company describing and illustrating Sprague electric hoists.

Refrigeration—Booklet entitled "Practical Talk on Refrigeration" issued by the United Ice Improvement Company, New York.

Trolley Catcher—The Electric Service Supplies Company have issued an attractive folder descriptive of Keystone Trolley Catchers.

Cut-out Hangers—Folder issued by the Thompson Electric Company, Cleveland, describing various types of single and double cord hangers.

Cooking Breakfast at the Table—Folder issued by the Westinghouse Company being a one act, true-to-life sketch of the modern breakfast prepared by electric devices on the breakfast table.

The Out Door Sub-station—Bulletin No. 13 issued by the Delta-Star Electric Company, Chicago, describing and illustrating their steel tower sub-stations complete with jib cranes and transformer table.

Automobile Lamps—Small catalogue issued by the Canadian General Electric Company entitled "Mazda Automobile Lamps for 1913 and 1914 Cars"; also pamphlet descibing AB Trumpet electric horns for motor cars.

Street Lighting—Booklet issued by the Canadian General Electric Company entitled "The attractive lighting of business streets." The booklet consists chiefly of typical lighting installations made by this company.

Panel Boards, Cabinets, etc.—Catalogue No. 21 issued by the Frank Adam Electric Company, St. Louis, Mo., describing and illustrating panel boards, cabinets, switches, switchboards, etc., manufactured by this company.

Annual Report—The Manitoba Public Utilities Commission have just issued their second annual report which covers the year ending November 30, 1913. The report covers 180 pages and deals with the various phases of the electrical situation practically all over the province.

Industrial Control—Bulletin issued by the Canadian General Electric Company describing push button control for motor drive in industrial plants. This bulletin is well illustrated and contains a number of valuable suggestions regarding "safety first" devices in industrial work.

Steel Tower Sub-Stations:—The Delta-Star Electric Company, Chicago, are distributing a bulletin devoted to a description of their new type steel tower outdoor high tension sub-stations. The bulletin includes 36 illustrations and will be valuable to those interested in this line of work."

Portable Instruments—Booklet issued by the Wagner Electric Manufacturing Company, St. Louis, entitled "A Manual of Electric Testing." This bulletin is very completely illustrated and in addition to minute explanations of the Wagner instruments includes a quantity of information, with line diagrams, on electric testing.

Textile Mills—No. 7 of the Textile Quarterly issued by the Westinghouse Electric & Manufacturing Company, describing power plants for textile mills. The Westinghouse Company have also issued Catalogue Section DS 845 which describes and illustrates porcelain and glass insulators for transmission lines up to 110,000 volts.

Electric Vehicles—The General Vehicle Company, Long Island City, N.Y., have issued a booklet entitled "Co-operative Advertising for Central Stations" in which they outline their system of assisting central stations to advertise electric vehicles at minimum cost. The same company are distributing a bulletin entitled "Good Store Service."

Rail Bonds.—The Electric Service Supplies Company have issued the 1914 edition of their catalog on Protected Rail Bonds and Appliances. The illustrations, besides showing the many different types of bonds, also show clearly the value of proper installation, the importance of accurate testing apparatus and the use of bond compressors. The section of the catalog describing and illustrating the methods of installing rail bonds enters into the subject in detail and indicates graphically the importance of assuring a perfect moisture proof contact between the bond and the rail.

Electric Cooking—The Hughes Electric Heating Company have issued a folder explaining the extent to which their electric ranges are used in Winnipeg. Apparently these ranges are especially favored in apartment houses, as, in seven apartment houses recently built there is a total of 95 electric ranges installed. Altogether it is stated that there are 2,500 Hughes ranges installed in Winnipeg. The folder also describes the new type of heating unit being installed in their latest range. This is a very quick heating unit designed for use where some item of cooking is required in a great hurry.

Current News and Notes

Brandon, Man.

Mayor Hughes is a strong advocate of the scheme for acquiring power from Winnipeg by a high tension transmission line by way of Portage La Prairie. The figures of cost to Brandon total approximately $310,000, made up of $12,650 (which is half cost from Winnipeg to Portage and $297,903 (being cost of line from Portage to Brandon with the necessary transforming and switching equipment). Mayor Hughes calculates that the total annual cost to Brandon would be $91,386 for 2500 h.p., which is made up of $50,000 for power (being 2500 h.p. at a cost of $20 per h.p.) and $41,386, depreciation, operating expenses, etc.

Brampton, Ont.

A contract has been awarded to the Northern Electric Company for the installation of a fire alarm system for the town of Brampton.

Broadview, Sask.

The British Canadian Engineering & Supply Company have obtained a contract for supplying the town of Broadview, Sask., with a Ruston-Proctor gas engine and producer plant of 72 brake h.p. and 50 kw. alternator, together with switchboard, exciter and all electrical equipment, both inside and outside the power house.

Cobalt, Ont.

The first of the two units being installed for the Northern Ontario Light & Power Company at Fountain Falls is now operating. This is a 1500 h.p. unit, Swedish General Electric manufacture. Fountain Falls is situated on the Montreal River, some two miles north of Hound Chutes.

Edmonton, Alta.

The city council have awarded to Escher, Wyss & Company a contract for the supply of a 6,000 kw. turbo-generator.

After first turning down the proposal to increase the street railway fare to 5c straight the city council have approved this recommendation and beginning May 17 this rate was established. The one exception is from 6 a.m. to 8 a.m., when tickets are sold at eight for 25c. The increase in rates has been necessary as the result of continued deficits in the railway department.

The generating equipment installed by the municipality during the past year comprises four Babcock & Wilcox boilers 4,870 sq. ft. heating surface, with chain grates and super-heaters; one 750 kw. Belliss-Siemens traction set complete with condenser; one 2000 Willans-Siemens turbo-alternator with condenser; one motor-driven ejector draft plant and stack of inverted funnel type, said to be the only one operating in Canada; one Paterson water softening, de-oiling and purifying plant, capacity 8,000 imperial gallons per hour; two Wier boiler feed pumps, each 7,500 imperial gallons per hour; one Venturi meter for boiler feed; one Avery automatic coal scale.

Two sub-stations were erected for traction purposes and are each equipped with a 500 kw. motor-generator. Power is supplied to these sub-stations at 6,600 volts, 3 phase, 60 cycles, by cable.

The producer-gas plant recently installed, as indicated by the recent report of the power house superintendent is manufacturing power at a cost, including all fixed charges, of 1.613c per kw.h. Power is supplied to the electric department at 3.345c per kw.h. and to the street railway department at 2.282c per kw.h. The power consumption of the electric light department was 13,490,590 kw.h. and of the street railway department 9,806,887 kw.h.

A representative of the consulting engineering firm of Porter and Sanderson of San Francisco and New York, was in Edmonton on the first of June and approached the city council with a proposal to develop water power on one of the numerous streams originating in the rocky mountains, a distance of 200 miles west of Edmonton. The offer of the United Colliery, Limited, of Winnipeg and Edmonton, to supply electrical energy to the city at three-fifths of a cent per kilowatt-hour plus twelve dollars per year per horsepower, was adversely reported on by the commissioner of operation and turned down by the council.

The Commissioner of Telephone Operation recommended an increase in telephone rates as follows,—Business wall telephone from $30 to $45; extra per year for desk telephone, $3; residence wall telephone from $20 to $24; extra per year for desk telephone, $3. This increase in rates to take effect on the first of July. The recommendation was adopted with the exception of the residence rate which remains unchanged.

Estevan, Sask.

Tenders are called for the supply of two 250 kw., 2,300 volt, 3-phase, 60-cycle generators for direct connection to producer gas engines; also one 500 kw., 2,300 volt, 3-phase, 60-cycle generator for direct connection to producer engine. The equipment will also include two exciters.

Granby, Que.

Messrs. Grant, Campbell and Company are constructing an extension of the Montreal & Southern Counties Railway line from St. Cesaire to Granby, P.Q.

Hamilton, Ont.

This city will invite some 200 guests to witness the inaugural turning on of the new nitrogen street lighting system, on July 1.

Kincardine, Ont.

A by-law will be submitted on June 25 to raise $3,500 for the purpose of changing over from an arc to an incandescent lighting system.

Lacombe, Alta.

The town of Lacombe have placed an order with the Canadian General Electric Company for a 100 kw. generator, 2,400 volts, 60-cycle, 3-phase, 600 r.p.m. This is to replace a 60 kw. machine as owing to the increase in power consumers it was found necessary to get a machine of larger capacity. Tenders for a 100 h.p. horizontal return tubular boiler working at 125 lbs. pressure have also been called. Lacombe has a water power which is now developing 60 kw. but the dam is getting old, and will have to be replaced by a concrete dam which will cost $25,000. Under the present conditions they are undecided whether it would not be advisable to give up this power altogether in favor of steam, as water is available for only eight months in the year.

Medicine Hat, Alta.

Magnetite arc lamps are being tried out on one of the streets of Medicine Hat. These are to be compared with gas arc lights placed on another street.

Montreal, Que.

There is a probability that the city will establish an electrical inspection department, to carry out work which is

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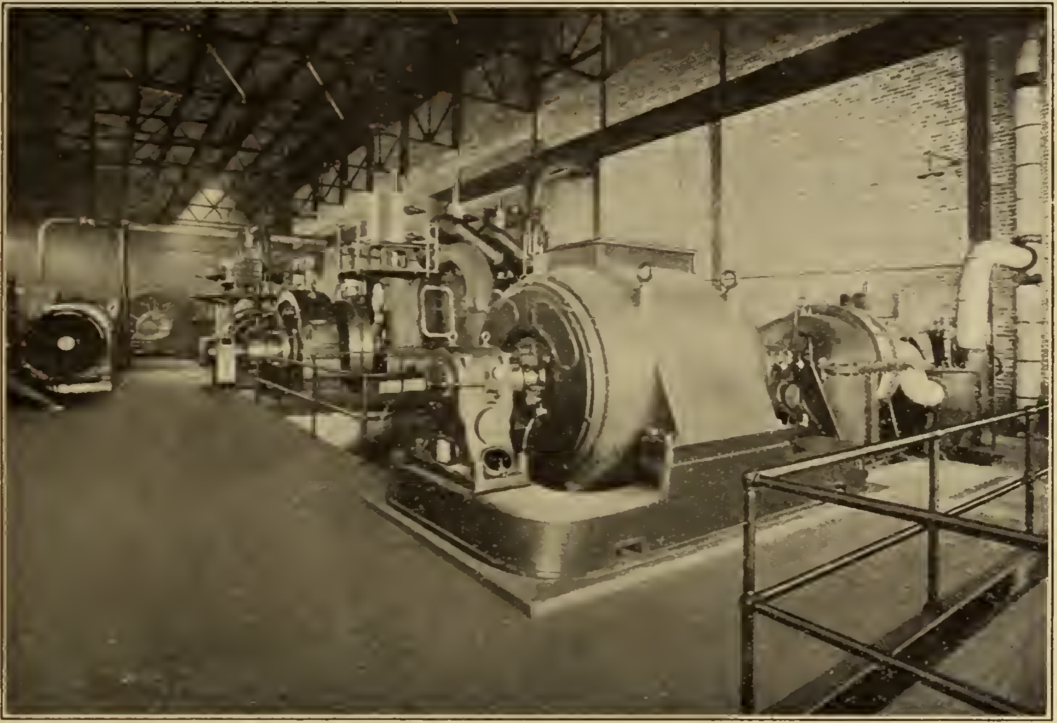

EDMONTON POWER HOUSE

The following SIEMENS machines are on order or installed in this plant.

1—6000 Kw. Turbo Alternator.
1—4000 Kw. Turbo Alternator.
1—2000 Kw. Turbo Alternator shown in the foreground.
1—750 Kw. Direct Current Generator behind the Turbo Generator.
1—425 H.P. Motor on the left.

Kindly send us your enquiries for all classes of electrical apparatus.

Siemens Company of Canada Limited

HEAD OFFICE:
Transportation Building - MONTREAL

BRANCH OFFICES:
STANDARD BANK BUILDING
TORONTO

McARTHUR BUILDING
WINNIPEG

now done by the Canadian Fire Underwriters' Association. The city have the necessary powers under the charter. It is understood that the city of Westmount also have under consideration establishing a similar department.

The gross revenue of the Montreal Light, Heat and Power Company for the fiscal year ended April 30, totalled $6,245,697, an increase of $736,141, while the net income, after paying fixed charges, was $2,399,268. Operating expenses rose from 42.3 per cent. to 44.5 per cent., due to advanced prices of raw materials. Mr. H. S. Holt, the president, stated that the steam reserve plant for the electric department at La Salle is equipped for 25,000 h.p. and designed for ultimately 50,000. The new steel pole transmission line between Cedars Rapids and Montreal is under way and will be completed simultaneously with the hydro-electric development of the Cedars Rapids Manufacturing & Power Company, with which the company has contracted for part of its power supply. It has been decided to reduce electric and gas rates, which means that electric light now costs the consumer about half the price it did seven years ago. The reduction announced affects net rates only. The gross rate will remain at 8 cents per kilowatt hour, but the discount is increased to 25 per cent., making the net rate 6 cents. This only applies to overhead service, the president stating that they cannot reduce the electric lighting rate for underground service; in fact the great difference in costs for this class of service as demonstrated by the cost of the new civic conduits and equipment will render it necessary to establish some fair differential to offset the additional cost entailed, and as the civic conduit system is extended into new territory, the consumers there will be required to pay increased rates for service.

Mr. George R. Tooke is now associated with Mr. Irving Smith, 809 Unity Building, Montreal. Mr. Smith represents several manufacturers of electrical specialties.

At the annual meeting of the Montreal Electrical Society the following officers were elected: President, J. N. Mochon; vice-president, L. E. Hamilton; secretary, J. C. Bray; treasurer, E. L. Brewer; board—contracting, W. H. Tees; commercial, T. R. Campbell; manufacturing, R. McIllwraith; traction, P. T. Davies. The report and accounts submitted by Mr. J. C. Bray and Mr. W. H. Tees respectively stated that there were 266 members and that the receipts were over $1,100. Notice of amendments to the constitution relating to fees and membership were given by Mr. Hamilton. Votes of thanks were passed to the retiring officers.

After prolonged negotiations the city of Montreal have made new arrangements with the Montreal Light, Heat and Power Company for the lighting of those streets on which underground conduits have been laid. This involves the disappearance of the existing poles, and the overhead arc lamps, the latter being replaced with ornamental standards each surmounted by a single magnetite arc lamp. The agreement with the city is for six years, and the price per lamp is $72.70 per 6.5 ampere magnetite arc lamp and $63.15 per 4 amp. magnetite arc lamp. Provision is also made for tungsten lighting, the prices being $23 for 80 c.p. and $16 for 40 c.p. lights. The city will supply the lights, standards, and cables, the equipment costing $39,500, and according to Mr. Arthur Parent, the civic superintendent of lighting, this will mean an additional charge of about $20 per magnetite arc lamp. As a beginning 200 lamps will be installed on St. Catherine and Bleury streets.

Ottawa, Ont.

The National Joint Commission have given their final order of approval to the Michigan Northern Power Company and the Algoma Steel Corporation for the diversion of water for power purposes from St. Marys River at Sault Ste. Marie. A diversion of 30,000 cu. ft. per second on each side of the river is allowed and this, it is estimated, will produce in the neighborhood of 100,000 h.p.

Owen Sound, Ont.

A new system of street lighting is being designed which is calculated to serve the purpose of better illumination until the advent of hydro-electric power, when the system will, it is said, be entirely remodelled.

Prince Rupert, B.C.

An order has just been received by the Herbert Morris Crane & Hoist Company through their agents in Vancouver, Messrs. Waddy & Young, for a 10-ton hand operated overhead travelling crane, fitted with Morris roller bearings to the main travelling motion. The new power house is well under way and is expected to be in full operation before the autumn.

Redcliff, Alta.

A by-law was recently carried authorizing the expenditure of $90,000 for extensions to the water and light services of the town.

Rouleau, Sask.

The Crescent Rural Telephone Company, Limited, have awarded a contract to Ross & Hayne, Regina, for the supply of material and the construction of their telephone system.

Sault Ste. Marie, Ont.

A daily weather bulletin for the Great Lakes is now being sent out from the radio station at Radio, Va., according to an agreement just arrived at between the United States Weather Bureau and the United States Naval Radio Service. This bulletin is sent out in two parts. The first consists of code letters and figures describing the points along the Great Lakes. The second part of the bulletin is a special forecast of the winds that will probably be encountered on the lakes. This is distributed to shipmasters on the Great Lakes by the Naval Radio Service during the season of lake navigation—usually from about April 15 to December 10—in the same way that weather conditions for the North Atlantic Ocean and the Gulf of Mexico are sent out. The latter service was begun in July of last year. It proved popular and the Weather Bureau was encouraged to extend the service to the Great Lakes.

Saskatoon, Sask.

A by-law was recently passed authorizing the expenditure of $200,000 for electric equipment and extensions.

Tenders are called for a 600 kw. rotary converter; also a 75 kw. motor-driven exciter, two 4,000,000 gallon motor-driven centrifugal pumps; three 400 kw. transformers together with the necessary switchboards, cables, etc.

Simcoe, Ont.

A by-law will be submitted authorizing the expenditure of $40,000 for the construction of a hydro-electric distribution system.

Stratford, Ont.

Contracts have been awarded in connection with extensions to the municipal street lighting system. The Hydro-electric Power Commission of Ontario have the work in hand.

Tavistock, Ont.

A by-law was recently carried authorizing the council to proceed with the installation of a hydro-electric distribution system.

Toronto, Ont.

The date for the vote on the hydro-electric radials throughout the Markham, Port Perry and Uxbridge district has been set as September 21.

The Hydro-electric Power Commission of Ontario have purchased a site on University Avenue, on which a building will be erected for the executive offices.

WESTON A. C.

Ammeters and Voltmeters, Wattmeters, Synchroscopes, Power Factor Meters and Frequency Meters, constitute a line of Switchboard Alternating Current Indicating Instruments which is unequalled. Send for our Catalogs giving full description of these instruments. They are accurate—durable dependable—and we stand back of them.

Demonstrations of the operative characteristics of these remarkable instruments may be observed in our New York office, and also in the offices of Selling Representatives in Philadelphia, Chicago, San Francisco and Toronto.

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Mr. Geo. H. Moseman, 176 Federal St., Boston, Mass.
Mr. Milton Mill, 915 Olive St., St. Louis, Mo.
B. K. Sweeney Electrical Co., 2910 Huron St., Denver, Colo.
Mr. Frank E. Smith, 682 Mission St., San Francisco, Cal.
Mr. S. C. Dinsmore, 1933 Dime Bank Bldg., Detroit, Mich.
Walter P. Ambos Company, 1729 East 12th St., Cleveland, Ohio.
A. H. Winter Joyner, Ltd., No. 76 Bay St., Toronto, Canada.
Weston Instrument Co., Ltd., Geneststrasse 5, Schoneberg, Berlin, Germany.
Mr. D. R. Petest, 415 Fourth Natl. Bank Bldg., Atlanta, Ga.
Mr. Edwin Wortham, Suite 28 Allison Building, 8th St. and Main St., Richmond, Va.
Montreal, Winnipeg, Vancouver, Calgary } Northern Electric Company Limited
Weston Electrical Instrument Co., Audrey House, Ely Place, Holborn, London, E.C.

Power Cables

Manufactured by

British Insulated & Helsby Cables, Limited

PAID-UP CAPITAL, $8,500,000.00

HEAD OFFICE—PRESCOT, ENG. Works at PRESCOT, HELSBY and LIVERPOOL

Illustration shows a No. 10 B & S, 3 conductor, paper insulated lead covered and double steel tape armored cable for a working pressure of 660 volts. This cable is for laying direct in the ground without any protection whatever and is similar to that supplied to the cities of Saskatoon, Prince Albert, etc., etc.

WRITE FOR ILLUSTRATED CATALOGUE

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Canadian British Insulated Co. LIMITED

MONTREAL, QUE.

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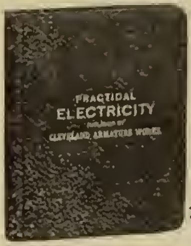

Every electrician should have a copy of this book.
Price - $2.00 delivered

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Condensers

Are celebrated throughout the world. The Wheeler Condenser & Engineering Co. was one of the first companies to concentrate its entire energy on the design of steam condensing machinery.

An office has recently been opened in

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122 Board of Trade Building
Mr. Joseph McKay, Jr., Manager

Wheeler Condensers are built in Barometric, Jet and Surface Types for moderate vacuum and for the highest attainable vacuums for steam turbine work. Vacuums of 28 to 29 inches and more are assured.

Wheeler Condenser & Eng. Co.
The Pioneer Condenser Builders
Works; Carteret, N. J., U. S. A.
Montreal, 122 Board of Trade Building

MICA
KENT BROTHERS
Kingston, Ont., Canada

Miners, Exporters and Dealers in Canadian Amber Mica.
Thumb Trimmed, Cut to Size, Splittings, Discs, Washers, Etc.

Write us for prices and let us figure on your requirements.

A by-law will be submitted early in July authorizing the expenditure of some $30,000 on motor busses to serve the districts not reached by the Toronto Street Railway Company and the municipal system.

Vancouver, B.C.

The Canadian General Electric Company are delivering three 100 kw. 3-wire, 125/250 volt, direct current, non-condensing steam generators for an addition to the power plant of the Hotel Vancouver made necessary by the enlargment of the premises. The power equipment has now reached the full capacity planned to meet the requirements of the new hotel.

The Government of British Columbia awarded to Escher Wyss & Company, of Montreal, the contract for one steam turbine driven centrifugal pump of 200 h.p. capacity, 1,500 r.p.m., through Frank Darling & Company, Vancouver, their agents in British Columbia.

Welland, Ont.

The Union Carbide Company of Canada, Limited, have recently placed an order with the Canadian General Electric Company for three (3) 3,000 kv.a. single-phase water-cooled transformers for Electric Furnace work at their Welland plant. These transformers are of particular interest on account of the heavy secondary current to be carried. They are designed for a range in secondary voltage from 115 to 175 volts with full capacity at all steps, calling for a maximum current of 26,100 amperes per transformer. These transformers will be fed from the new lines of the Hydro-electric Power Commission at 45,700 volts. Six 3,500 kv.a. step-up transformers also of Canadian General Electric manufacture are now being installed at Niagara Falls for the supply of this line.

Winnipeg, Man.

Tenders are called by the Board of Control for the supply of globes, electrodes, etc., for street lighting purposes.

Lighting Schedule for July, 1914

Courtesy of the National Carbon Company, Cleveland.

Date.	Light.	Date.	Extinguish.	No. of Hours
July 1	10 40	July 2	3 50	5 10
2	11 10	3	3 50	4 40
3	11 50	4	3 50	4 00
5	0 30	5	3 50	3 20
6	1 30	6	3 50	2 20
7	No Light	7	No Light	
8	8 00	8	10 20	2 20
9	8 00	9	10 50	2 50
10	8 00	10	11 10	3 10
11	8 00	11	11 30	3 30
12	8 00	12	11 50	3 50
13	8 00	14	0 10	4 10
14	8 00	15	0 30	4 30
15	8 00	16	0 50	4 50
16	8 00	17	1 20	5 20
17	8 00	18	1 50	5 50
18	8 00	19	2 30	6 30
19	8 00	20	3 20	7 20
20	8 00	21	4 00	8 00
21	7 50	22	4 00	8 10
22	7 50	23	4 00	8 10
23	7 50	24	4 00	8 10
24	7 50	25	4 10	8 20
25	7 50	26	4 10	8 20
26	7 50	27	4 10	8 20
27	7 50	28	4 10	8 20
28	7 50	29	4 10	8 20
29	7 50	30	4 10	8 20
30	7 50	31	4 10	8 20
31	10 30	Aug. 1	4 10	5 40

Total Hours 170.10

ELECTRIC REPAIRS

OUR SLOGAN—

We can keep you running while we make your repairs.

HOW?—

By having in stock the largest supply of new and secondhand Electrical Apparatus in Canada from which we can loan you something while we make your repairs.

Fred Thomson Co. Limited

326-328-330 West Craig Street
MONTREAL

WE BUY SELL AND EXCHANGE

Do not scrap your old Generators, Motors, Switchboards, etc. Write and ask us what we will allow you for them.

We extend a cordial invitation to all members of the Canadian Electrical Association to visit us while in Montreal.

Condensed Department

Publisher's Notice

Advertisements under "Situation Wanted" "Situation Vacant" or Miscellaneous, are charged at 2 cents a word per insertion, minimum charge 50 cents.

Advertisements for tenders, equipment, wanted or for sale, etc., are charged at $2.10 per inch.

All advertisements must be in the publisher's hands by the 10th or 23rd of the month to insure insertion in the subsequent issue.

FOR SALE

One 115 kw., 2300 volt, 60 cycle, 3 phase, Allis-Chalmers, Bullock Alternating Generator with exciter, switchboard and instruments complete. Machinery in use three years. For further particulars apply to Chapleau Electric Light & Power Co., Chapleau. t.f.

FOR SALE

1—I.T.E. 800 amp. type N X circuit breaker, three pole.

4—60 omp. 150 volt 2 wire Sangamo integrating watt meters.

2—100 amp. 230 volt 2 wire Sangamo switchboard type integrating watt meters.

The above equipment is absolutely new and has never been used, and will be sold at a sacrifice. Apply George J. Beattie, "The Electric Shop," 72 Victoria Street, Toronto. 12

TENDERS

TOWN OF ESTEVAN, SASK.

Proposals addressed to P. J. Stephens, Secretary-Treasurer of the Town of Estevan, will be received up to 15th of July, 1914, for the supply and erection of the following:

Two 250 kw., 2,300 volts, three phase, 60 cycle, alternating current generators for direct connection to engine.

Two exciters for direct connection to above generators.

One 500 kw., 2,300 volt, three phase, 60 cycle, alternating current generator for direct connection to above generator.

One exciter for direct connection to above generator.

Three gas engines, using producer gas for above, complete with all gas generators, tar and dust extractors, and all the necessary gas and water piping. Producers to use Estevan lignite coal, 8,000 B.T.U.'s.

One switchboard, complete for the above units.

Further particulars to be obtained from S. G. Dethridge, Town Electrical Engineer, Estevan. The Council do not bind themselves to accept the lowest or any proposal.

JAS. A. SMITH, Mayor,
P. J. STEPHENS, Secretary-Treasurer.
S. G. DETHRIDGE, Town Elec. Engr.
12

Situations Vacant

Contracting Superintendent

Wanted Superintendent for electrical contracting business having estimating experience. Apply giving full particulars to Box 26, Electrical News, Toronto. 11-12

Wanted

Live manufacturer's agent to handle entire line of a large electrical manufacturer of power house specialties, on a commission basis. Address, with full particulars to Box 34, Electrical News, Toronto. 12-13

Superintendent Wanted

Superintendent for large electrical contracting work. In replying state age, experience, general qualifications and salary wanted. Reply by mail only to Keiths Limited, 297 Campbell Ave., Toronto. 12-13

Situation Wanted

Electrical operator desires change; five years' experience in A.C. and D.C. plants, steam and hydro; young, unmarried. Apply Box 400, Electrical News, Montreal. 12-13

Engineer or Manager

Electrical Engineer, 28, married, wants position as engineer or manager of small electric plant, or assistant engineer of large concern. Broad experience. A-1 reference. Box 41, Electrical News, Toronto. 12

Electrical Engineer

Electrical Engineer, experienced in the Design and Installation of Transmission and Distribution Systems, seeks engagement. Seven years superintendent of Construction for large firm of cable manufacturers, in charge of installing underground conduit and cable systems. Best of references. At present employed. Box 39, Electrical News, Toronto. 12

Electrical Engineer

Position Wanted—Electrical Engineer, Associate A. I. E. E., age 33. Thirteen years' practical experience with D.C. and A.C. machinery, Accumulators, Line erection and maintenance, High speed steam engines and water power plants. At present in charge of Suction gas plant. Box 11, Electrical News, Toronto. 9 13

Business Opportunity

Eastern Manufacturers or Supply Houses wishing Manager for Western Branch would do well to apply to undersigned Technical Engineer with ten years' experience in Constructing, Estimating, Selling, and Managing. Engineer, Box 486, Winnipeg. 12-13-14

SECOND HAND ELECTRICAL MACHINERY

Bought, sold, rented, and exchanged. We have the largest stock in America. Send for our monthly bargain sheet showing complete stock with our prices.

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Established 1893

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TRUSTEES - FINANCIAL AGENTS.
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Electrical Machinery
Motors, Dynamos, Generators,
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Works at: Hermsdorf (S.---A.) and Freiberg (Saxony)

Largest Porcelain Insulator Works ∴ Known All Over the World
1,500 Hands - - 36 Ovens

Specialties: High Tension Insulators, (Suspension Types) (Metal Covered Insulators)
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31 Cedar Yards in B.C. Wash. and Idaho

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Medicine Hat
Stettler
Strathcona
Suffield

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Canora
Caron
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Macoun
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Dundas
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Paris
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Phelpston
Port Arthur
Port Credit
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Rathburn
Rockwood
St. Marys
Seaforth
Sebringville
Springford
Stayner
Stratford

Ontario
Sunderland
Tillsonburg
Toronto
Trenton
Udney
Victoria Park
Walkerville
Walkerville Jct.
Washago
Waterloo
Welland
Weston
Windsor
Woodstock
Woodville

Quebec
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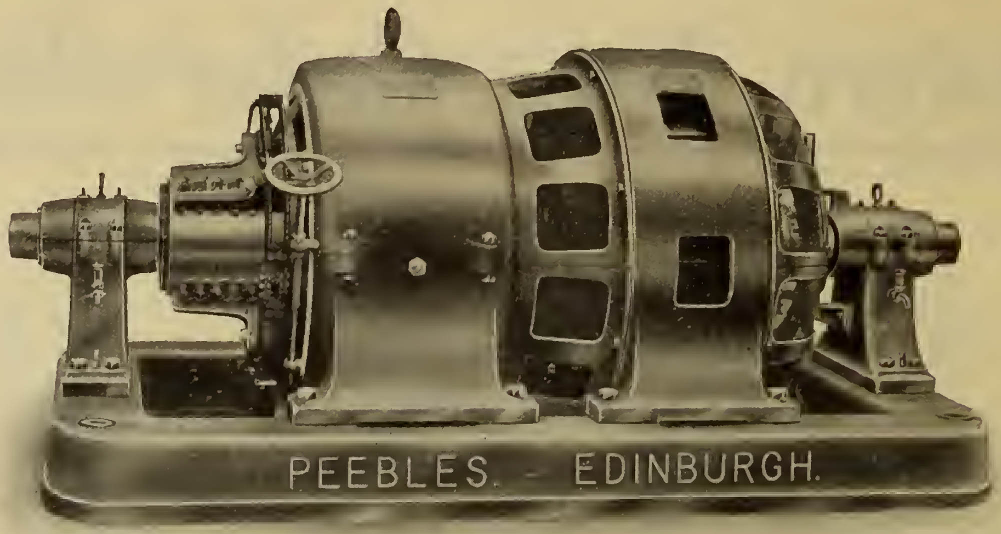
We have EXTENSIVE STOCKS of B. C. CEDAR POLES of all sizes to take care of our customers in the CANADIAN PROVINCES.

If your "Town" doesn't show in the above list send us your inquiries and orders that we may add it.

WRITE OR WIRE

Western Lumber & Pole Co.

Main Office - Denver, Col. - "Electric" Bldg.



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These Laboratories are equipped with Instruments and Apparatus for the testing and comparing with Standards, of all types of Electrical Measuring Instruments and Appliances.

They are authorized by the **Weston Electrical Instrument Company of Newark, N. J.,** to repair, calibrate and check instruments of their manufacture in use in Canada.

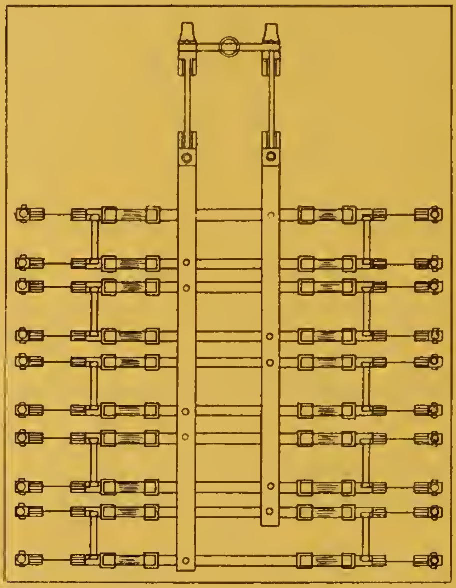
Facilities have been provided for the prosecution of research work in connection with Electrical, Electro-Chemical and Mechanical investigation and development.

Instruments, Apparatus and Expert Services are available for Efficiency and other tests on Operating Plants, Acceptance tests of new Installations and tests of Electrical Machinery, Apparatus and Appliances of every description. In this connection our equipment and services are particularly available for the use of Consulting Engineers.

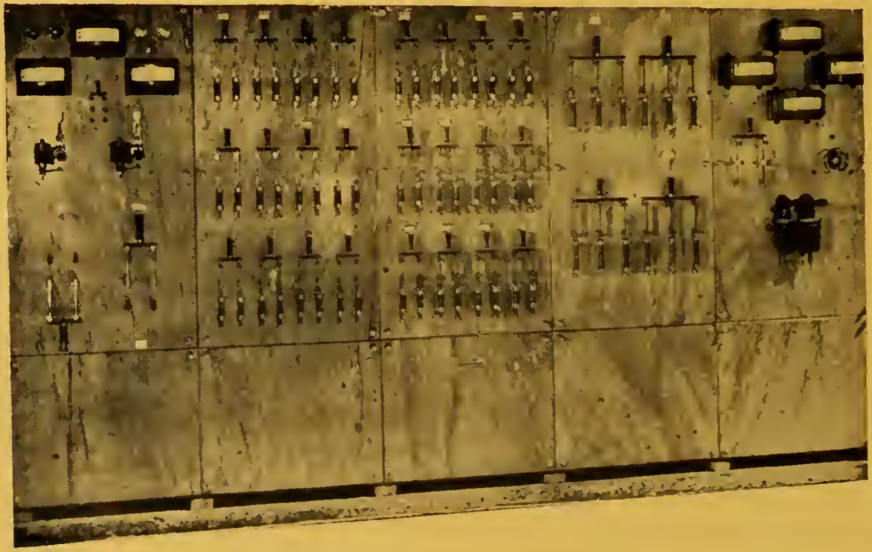
Expert advice may be obtained on partially completed Electrical and Mechanical devices or processes and development work may be arranged for if desired.

DEVOE

Panels and Switch Boards



We design and manufacture SWITCHBOARDS, PANELBOARDS and CABINETS of every description.



Quotations
promptly
made upon
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drawings or
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are submitted.

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No. 6.

We specialize on SWITCHBOARDS

The Devoe Electric Switch Co., **157 Craig St. West**
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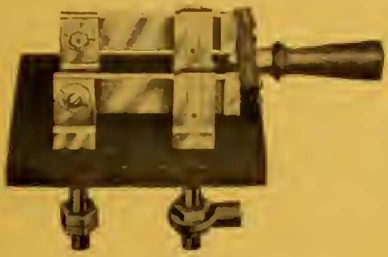
Frank G. Scofield, Ontario Sales Representative, Lumsden Building, Toronto, Ontario

DEVOE

Switches and Steel Boxes

An examination of DEVOE switches and steel boxes will convince you they are the best made.



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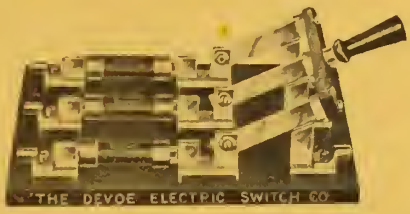
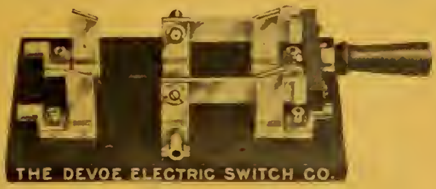
Type "A"

Every DEVOE product is built for efficient service under actual operating conditions.

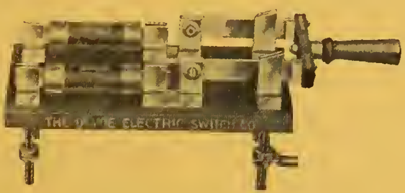


Cut No. 343

These boxes are formed from one piece of steel, the corners of the bodies are folded in and securely riveted.



The corners lap over the edges of bodies on all four sides making these boxes absolutely DUST PROOF.



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When specifying insist on Devoe Switches and Steel Boxes

The Devoe Electric Switch Co., **157 Craig St. West**
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Two Specialties

B. H. Bell Transformers

a reliable substitute for batteries

We have made a minute study of the ringing of bells by means of small transformers, as a real solution to the unreliable method of using batteries; and in consequence, we have developed, and now offer to the trade our MODEL C here illustrated, which has all the fine characteristics of our Model B except that it is of lower capacity. It is designed to meet the demand for a low capacity ringer suitable for the great volume of private residences, etc.

The Lyhne Lamp

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The **Lyhne Lamp** puts the light where you want it—not in your eyes.

Three finishes :

Brush Brass

Oxidized Copper

Nickel Plated

The Perfect Reading Lamp

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Representing :

Dossert & Company, New York, N.Y., Dossert Solderless Connectors for Solid and Stranded Wire.
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Canadian Krantz Elec. & Mfg. Co., Toronto, Ont. Panel Boards and Switch Boards.
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Lancashire Dynamo & Motor Co. of Canada, Limited, Toronto, Ont. Motors and Generators.
Renfrew Electric & Mfg. Co., Renfrew, Ont., Heating & Cooking Apparatus.
Eastern Malleable Iron Co., Naugatuck, Conn. Pins and Brackets.
Sterling Telephone & Electric Company, Limited, London England. Electric apparatus supplies and telephones.

SAFETY FIRST

This is Assured by Using

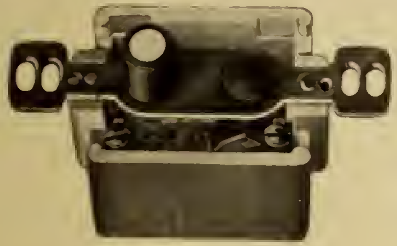
Monarch Specialties

Push Button Flush Switches

Single Pole, Double Pole, Three Way
With or without Brass Plates
Design and Construction Guarantees
Durability, Accuracy in Operation.

Pull Chain Sockets

Supplied in Polish Brass, Brush Brass, Nickel Plate and Oxidize Copper Finish, From Stock, Other Finishes to Order.



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Monarch Electric Company, Limited

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"BROOK" BALL BEARING MOTORS

ALL SIZES CARRIED IN STOCK

SINGLE
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FOR ALL
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Standard protected type, Slip-Ring Motor

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"GOOD POLES QUICK"

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British Columbia Cedar Poles

shipped from some one of our 14 pole yards in Canada. Our Canadian Stocks are by far the largest and most complete.

May we quote you?

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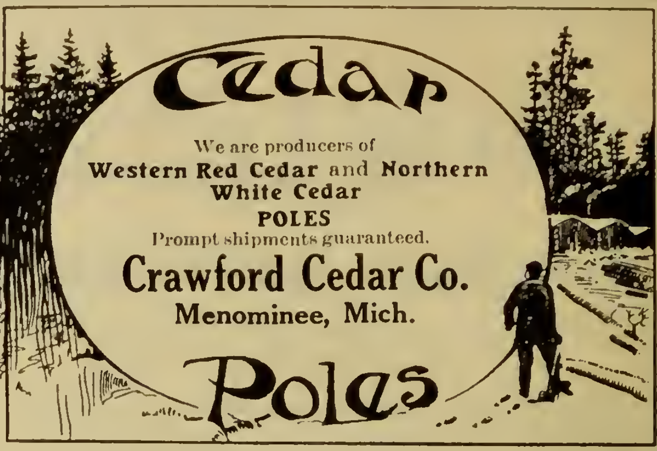

Cedar

We are producers of
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Prompt shipments guaranteed.

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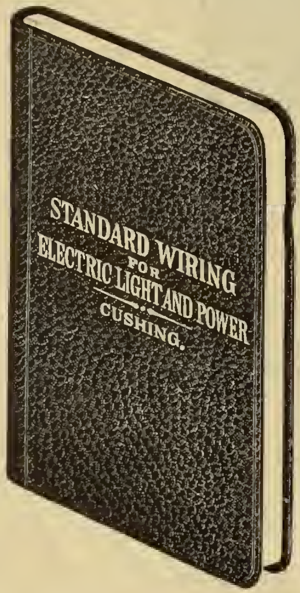
20th Year 20th Edition



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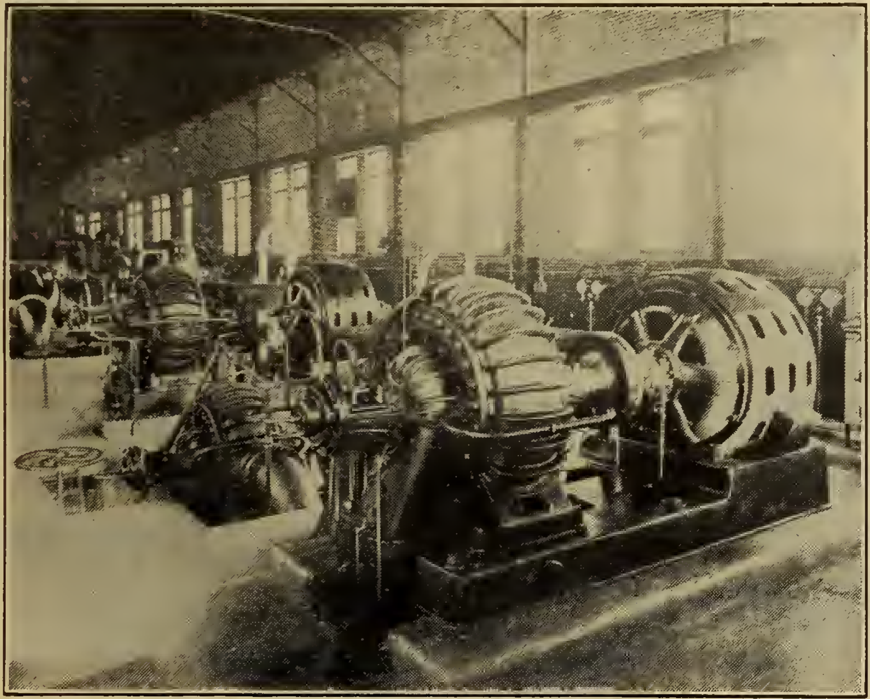

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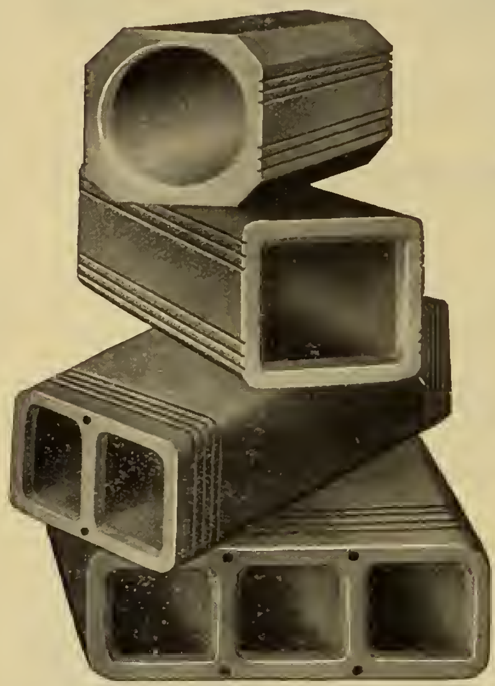

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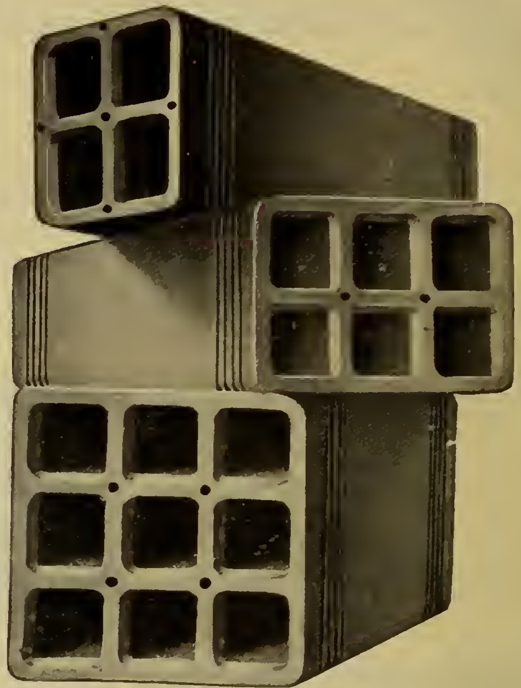

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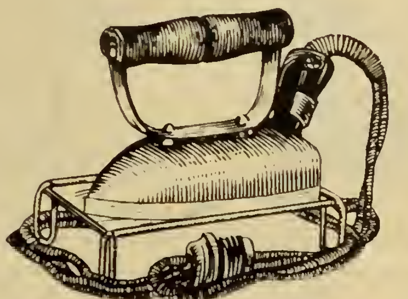

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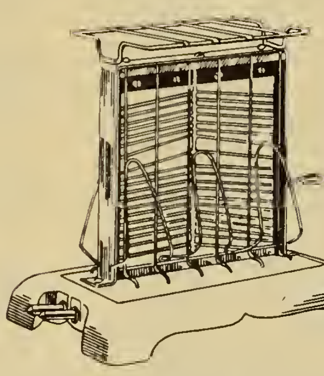

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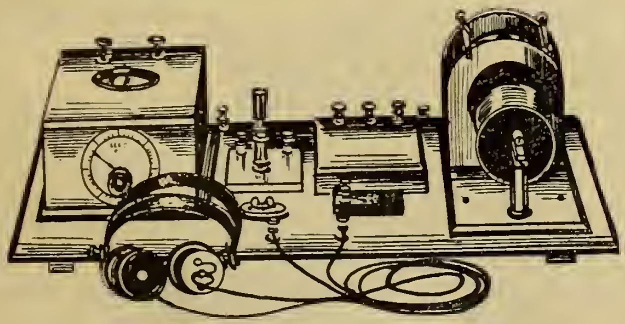

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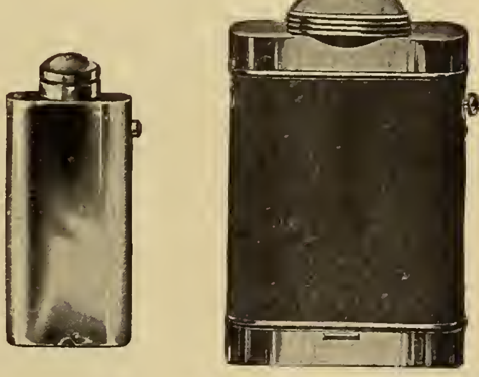

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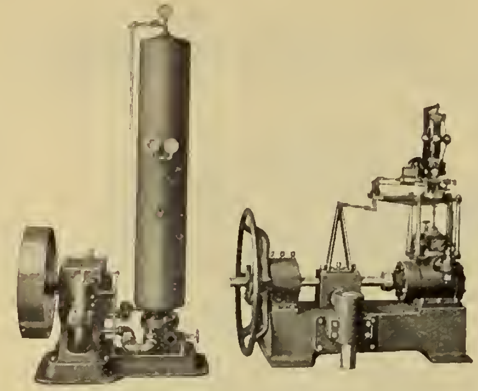

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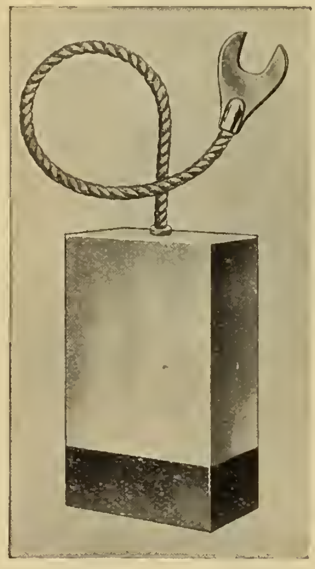

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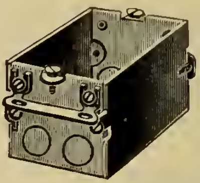

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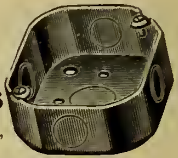

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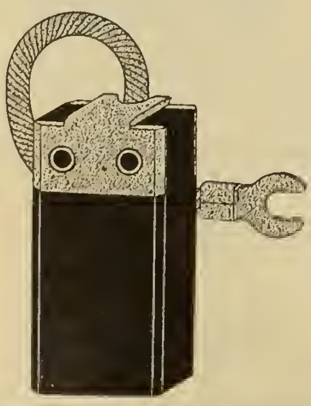

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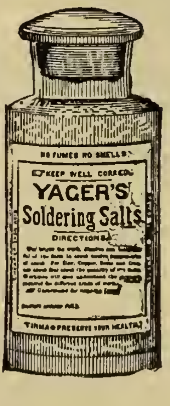

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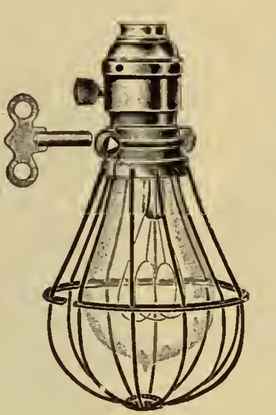

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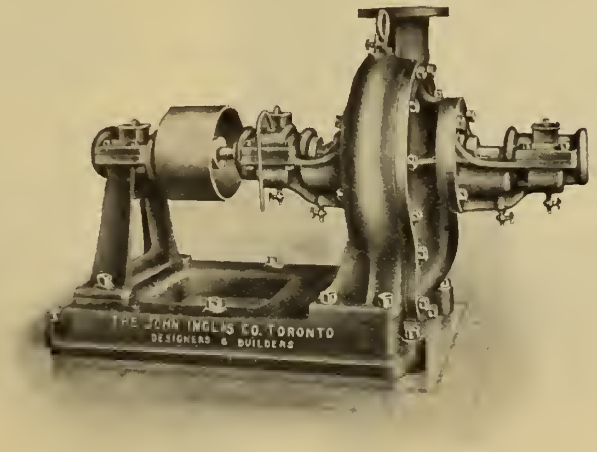

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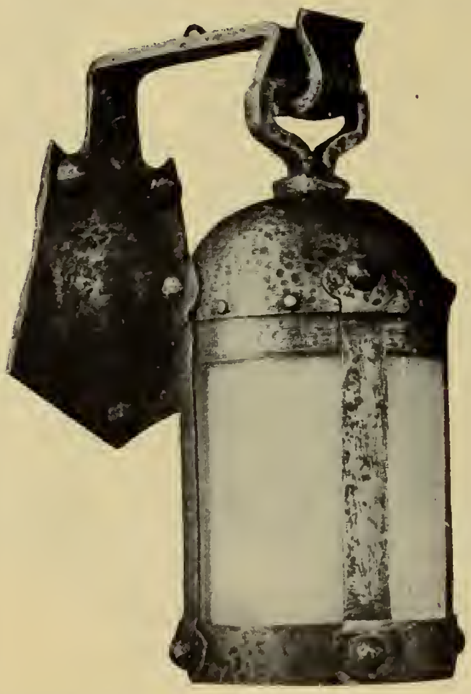

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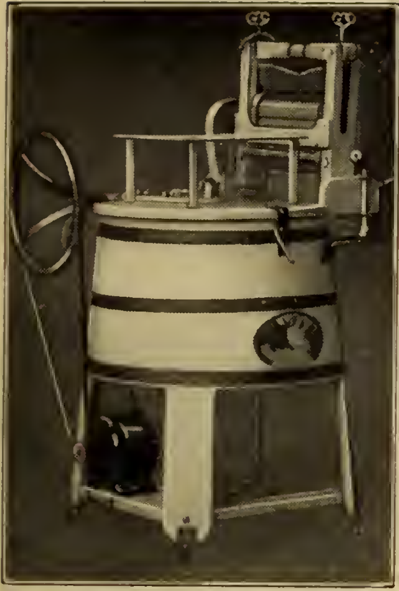

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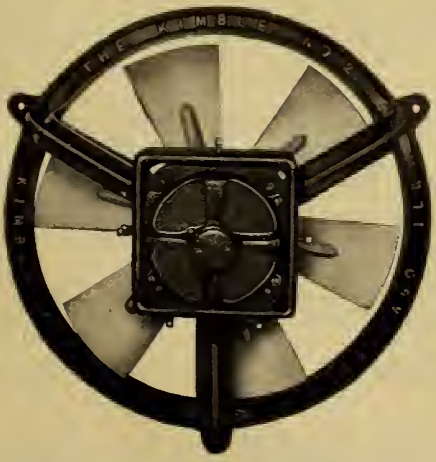

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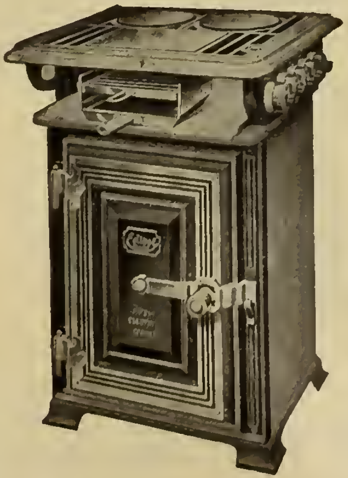

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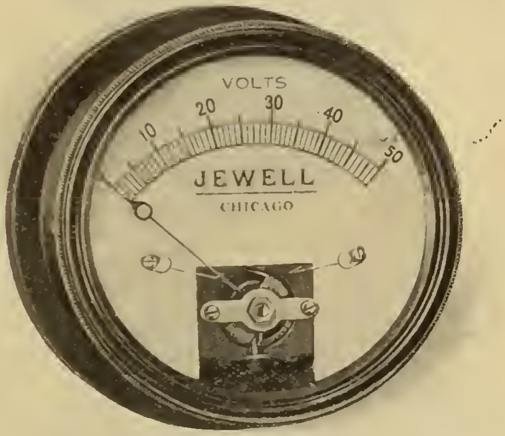

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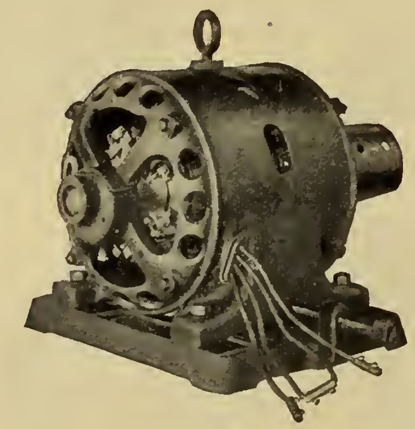

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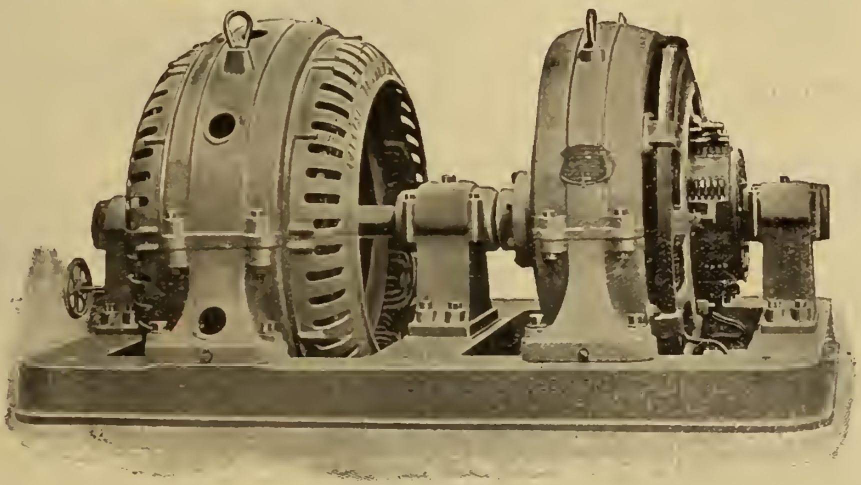

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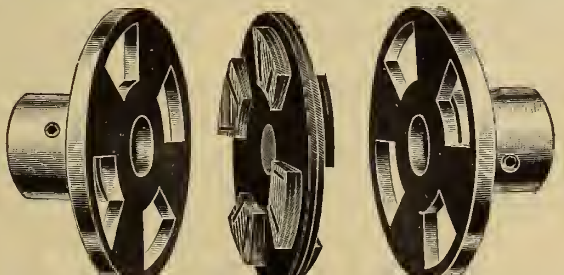

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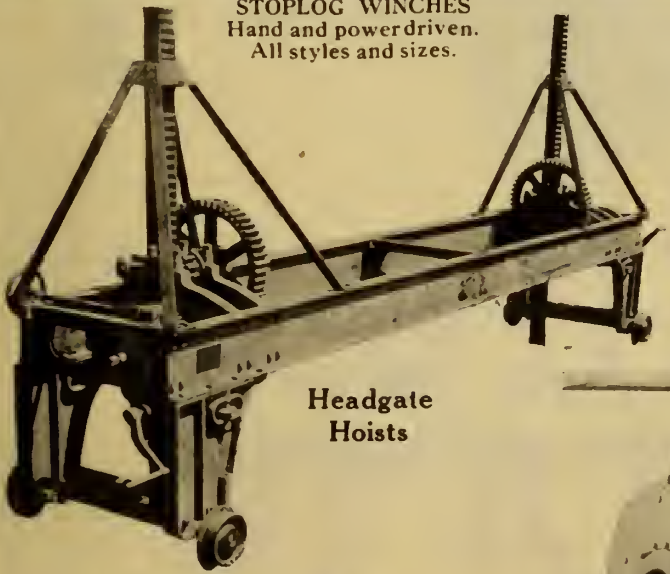

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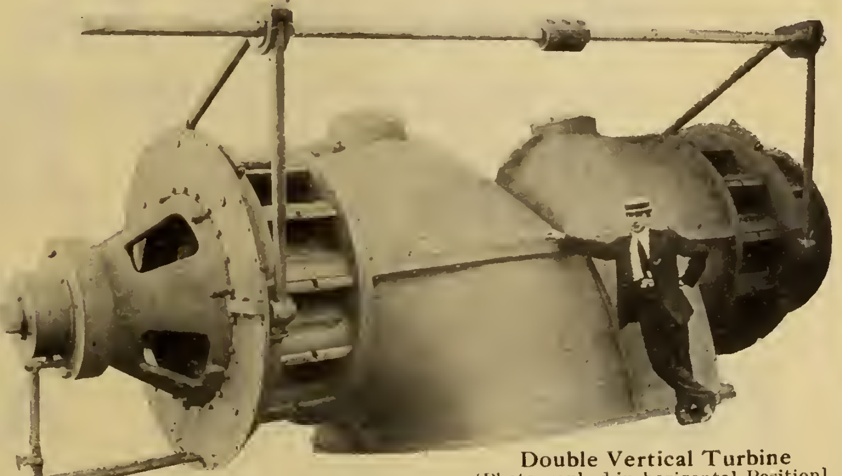

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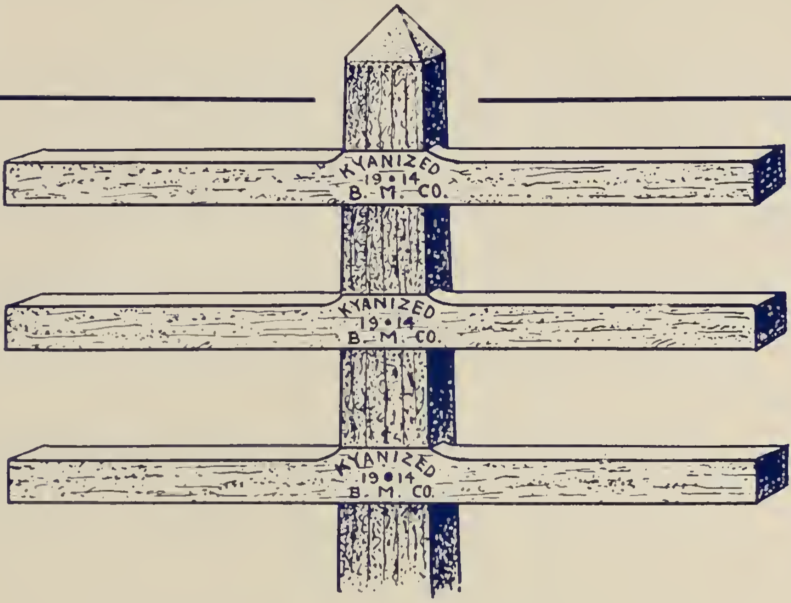

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